Francis, David Pitt, 1979.
The contribution of capital finance to the social productiveness of public lending libraries.

THE CONTRIBUTION OF CAPITAL FINANCE TO THE SOCIAL PRODUCTIVENESS OF PUBLIC LENDING LIBRARIES

by

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An Abstract of the Thesis

The thesis attempts to value investment in libraries with a Hicksian model: $V_o = \Sigma[I_t/(1 + r)^t]$; $t = 0......j$; where V,I,t,j,r are respectively value, expected income, time intervals, time horizon and social discount rate. Income (except e.g. rents, fines) is non-monetary and must be objectively estimated as a social benefit. Externalities (1) and non-user benefits (2) are excluded because they are usually subjectively estimated and are treated elsewhere (1 & 2). Methods applied to education benefits (3) are also shown invalid to estimate public library benefits, inter alia because such benefits are complex, comprising both education (investment) and leisure-reading (consumption).

The principal hypothesis is that social income from all public library system book activities is best estimated by converting bookloan statistics. These are powerful measures of total 'book' activity, including non-lending (e.g. browsing, reference etc.) functions because of the lending function's (i) relative size; (ii) satisfaction of library objectives and (iii) significant correlation with all non-lending 'book' (as opposed to 'non-book' e.g. cultural) functions. Though it is not suggested that library objectives are satisfied by maximising bookloans, it is postulated that bookloan statistics can be converted to reliable aggregate social income estimates using a multiplier Σm_i where m_1 is the 'average' reader's modal bookloan-benefit, and $m_2.....m_j$ realistic apportionments of correlated non-lending benefits per bookloan, using the conversion, where t is year t: $V_o = \Sigma[(L_t.\Sigma m_i - C_t)/(1 + r)^t]$; $t = 0.......j$; where L_t and C_t are respectively the frequencies of bookloans, and revenue costs. Chapter 1 examines primary (questionnaire and library observation) evidence for the hypothesis, and 2 examines the variation of the issue statistic. Chapters 3 and 4 respectively examine the asymmetric frequency distributions of issues (bookloans) and capital expenditures (per capita) while 5 traces the general effect of capital on issues by correlation with indices of period change in issues. Chapters 6, 7, 8, 9 trace the specific effects of investment in buildings, mobiles, bookstocks and human resources respectively, assessing their differing marginal efficiencies. The conclusions are summarised in chapter 10.

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(1) to (3) See subsequent pages.

An Introduction to the Theoretical Background of the Current Work

It is required that the abstract on page i be confined to approximately 350 words. Thus it can be no more than a purposive summary. The following introduction explains the raison d'être of the thesis and its theoretical substructure at greater length.

Theory is concerned with the development of a systematic set of concepts or models that can be used to relate, explain or predict groups of facts or phenomena. This thesis is concerned with the development of a valuation model. Accounting theory attempts to answer the difficult problem of valuation by examining it from several different aspects. It is a limitation of accounting data that values of fixed assets such as buildings cannot be precisely assigned, because such assets are dissimilarly valued by different owners, joint-owners and users. Thus accountants and economists examine the value-problem from different conceptual standpoints, e.g. (i) current cost; (ii) current replacement value; (iii) value in exchange; (iv) value in use; (v) current opportunity cost, using mathematical programme shadow-cost solutions; and (vi) the so-called 'investment appraisal' model.

In theses of this kind, it is usual to describe a number of different theoretical models, and then to provide empirical evidence for the acceptance of one or several of them. Thus, this thesis could have commenced with a lengthy 'ab initio' consideration of all the alternative bases of valuation (such as (i) - (v) supra), giving the reasons for their rejection in favour of (vi), the 'investment appraisal' (or 'Hicksian')model. But there are strong reasons for not doing this in the case of public library valuation. Unlike domestic, commercial and industrial premises, public libraries are not purchased and sold as such. Therefore, accounting 'concepts' such as (i) current cost; (ii) current replacement value and (iii) value in exchange, are not relevant to our problem. 'Concept' (iv), value in use, is unhelpful, for though specific rooms in library buildings may be rented, whole library buildings are not used for alternative purposes. A mathematical-programming approach is unhelpful for formulating a general theory of valuation of capital inputs into public libraries, because inputs and outputs are so diverse that it produces multiple solutions.

Thus, because of the unique nature of the public library valuation problem we can reject these alternatives in favour of the model, that I term 'Hicksian' as a 'shorthand' expression, – not because it is attributable to Hicks, but because of its erudite development by him in other contexts (e.g. in both 'Capital and Growth' XX and 'Value and Capital' XVII)(3a) to trace theoretical relationships between capital, consumption, income and value. The model is now popularly used, both by educational economists (3) and by accountants. It defines the value of an asset at a given time (V_o) as the sum of a series of expected future 'consumption' benefits (I_t), adjusted to accommodate time preference by using a discount (or reciprocal 'interest') factor, $1/(1 + r)$. This theoretical model is an 'ideal' generalization, but has the disadvantages that future consumption ('income') benefits are, at best, estimates, and that people have different time preference rates.

In this thesis we ask whether this model of the relationship between investment, value and future consumption can be related to the capital investment projects of public libraries where social 'consumption' benefits cannot be precisely expressed in monetary terms.

In the title, I deliberately adopted the phrase 'social productiveness' instead of 'productivity' to avoid confusion with the specific meaning assigned to productivity in Hicks (3b) XXII, for in this thesis the measurement is largely that of non-monetary 'consumption' benefits. It is difficult to impute precise 'money-values' to public sector benefits, such as those from hospital treatment, refuse disposal and the police service. The valuation of public library benefits is even more difficult and challenging because (i) libraries provide a diversity of different, but related, services and (ii) the largest library function, the lending function, is not concerned with providing homogeneous units (such as patient -beds in the hospital service) but with (a) heterogeneous bookstocks administered to (b) heterogeneous readers, whose individual tastes are (c) heterogeneous over time. These three factors render each 'issue' (loan) characteristically distinct and episodic.

Thus, public library issue statistics must be used with full awareness of this limitation. Questionnaire methods also have limitations, for assessing 'annual benefits' from libraries. These benefits could be assessed more accurately by the painful public 'experiment' of - introducing subscriptions at different prices, and then calculating sequentially the weighted average 'opportunity cost' value from numbers prepared to take out subscriptions, with safeguards against ticket-transfer! But an individual researcher must rely on questionnaires, test-checking his results by reference to other factors, such as those listed on page 17 (e.g. the public lending right).

Theory must serve to generalise, to be holistic and widely embracing. It may be easy to assess the values of specific libraries to sections of a community. For example, some city libraries provide export information to firms, and the 'added value' of resultant export orders is quantifiable. The 'investment value' of some specific public libraries widely used by professional students may also be quantifiable. Blaug's (3c) criteria can be applied to specific reference books. But these three examples are 'partial' and cannot meet the demands of theoretical treatment, for (i) libraries are charged with the duty of serving a public as a whole (not simply business or student communities) and (ii) the libraries in these (e.g. city) examples form an insufficiently large proportion of United Kingdom libraries to be a valid sample. This thesis has to reinterpret the valuation model of Hicks and others, so that the 'consumption-value' equivalents of all library book-benefits to all members of a community can best be estimated.

The problem of valuing library benefits first interested the writer while preparing for accountancy examinations in the 'fifties, was revived after work on a human-behaviour computer model for the London M.Sc dissertation in 1970, and was pursued as a cost-benefit study of London libraries for the City University M.Phil awarded in 1975. The current thesis does not attempt to trespass in areas where library-science specialists have greater expertise, and the writer is, for example, aware of the current (3d) Centre for Research on User Studies investigation of library usage which, when complete, may validate some conclusions of this thesis. This thesis is specifically concerned with capital expenditure on libraries, and attempts to interpret the Hicksian 'investment appraisal' valuation model in the context of United Kingdom library data as a whole.

<u>A Statement of the Methodology used in the Thesis</u>

To shorten explanation, having stated the principal hypothesis in the Abstract (i), I shall use the Roman numerals I, II and III to denote the three major problems with which this thesis is concerned, the relationship between these three problems being shown in the Frontispiece diagram on page xx:

(I) whether $L_t \Sigma m_i$ is a valid estimator of the benefit (= social income) from 'book' activities of a public library system where m_i is the 'average' value of the 'average' bookloan to an 'average' reader, and where $m_2 \ldots\ldots m_j$ are additive adjustments to this value, -to include benefits that are known to correlate in activity with the lending activity (e.g. browsing, information, inter-library services and reference services) at a significant level, but do not include subjectively estimated benefits, e.g. externalities (1); non-user benefits (2); ultimate community educational (investment) benefits (3) and non-book benefits (e.g. from cultural and child-minding (quester) activities), these being excluded from our terms of reference for reasons given elsewhere;

(II) whether an investment of capital in libraries normally leads to an increase in the <u>gross</u> social benefit $L_t \Sigma m_i$ or in the <u>net</u> social benefit, $L_t \Sigma m_i - C_t$, where L_t is the number of loans (or issues) at time-point t, m_i is as defined above,

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(1). See particularly Karunaratne, N.D.: Assessing Performance in Libraries, Long Range Planning Vol II: April, 1978 (pp. 66-70). This article, based on Dr. Karanuratne's research project 'Cost of Public Libraries in Australia' uses a methodology very similar to that in my prior M.Phil Thesis (1975)(T.C.U.). Its difference from both my theses is in its data (Australian) and in its approach (i.e. performance measurement rather than valuation). It was also completed later than both my research projects.

(2). Hu, T., Booms, B.H., and Karltreider, L.W.: Benefit-Cost Analysis of Alternative Library Delivery Systems (Greenwood: 1975) suggest a 25% addition for non-user benefits (p.202).

(3). Blaug, M. (ed) The Economics of Education (Pergamon, 1970).
Sheehan, J. Economics of Education (Studies in Education: Allen and Unwin, 1974).
Vaizey, J. The Economics of Education (Studies in Education series: Macmillan, 1973).

(3a). See Hicks, J.R. Capital and Growth (Oxford:1965) Chapter XX, The Intertemporal Production Frontier, for a theoretical treatment. Also Hicks, J.R. Value and Capital (Oxford:1946)XVII.

(3b). Hicks, J.R. Capital and Growth (supra) XXII Interest and Growth

(3c). Blaug, M. Economics of the Arts (Martin Robertson: 1976).

(3d). Centre for Research on User Studies: CRUS News (Sheffield University: occasional, e.g. July, 1978).

where C_t represents the revenue costs of the system for year t; and

(III) whether capital expenditure on particular capital categories (e.g. buildings, mobiles, books and human resources) are more or less efficient than other categories, judged by their effect on issues, and hence on $L_t \Sigma m_i$.

Before considering problem I, it is necessary to state why library benefits cannot be reliably estimated, using the same methods as those used (4) by Becker for the valuation of human capital and by (3) Blaug, Sheehan and Vaizey for measuring investment in education. The case is argued from a number of standpoints, e.g. the consumption (leisure) aspect of library usage, inter-library transferability and the problem of reliably estimating any particular library system's contribution (per se) to aggregate 'ultimate' benefit. Because of their book-content homogeneity, public libraries are, however, shown to be more comparable with each other than academic libraries (5), and evidence is thus produced for a 'holistic' view of benefit (i.e. based on estimators of activity of the system as a <u>whole</u>, rather than attempting to measure specific indicators of lending, browsing, information, reading-room, reference etc. usage), for statements of library objectives require that public libraries be judged holistically, rather than sectionally,-as academic libraries (5). By using questionnaire methods, observation counts at libraries and secondary data, it is shown that library loan

(4). Becker, G.S.:Human Capital (National Bureau of Economic Research: Washington, 1965).

(5). Baumol, W.J. et al: Economics of Academic Libraries (American Council on Education:Washington,1973) Raffel, J.A. and Shishko, R. Systematic Use of University Libraries, An Application of Cost-Benefit Analysis to the M.I.T. Libraries (The M.I.T. Press,Cambridge,Mass,1969).

frequency statistics are the best estimator of 'total' activity, because of the relative size of the lending function, its satisfaction of library objectives and its significant positive correlation with all other functional activities. I showed earlier (6) that the 'average' value of a bookloan to an 'average' reader can be valued as an opportunity cost (m_1). Using questionnaire methods, it is shown that it is not only possible to obtain reliable estimates of m_1 and thus $L_t m_i$, the 'benefit' from the lending activity, as previously evidenced for London (6), but also calculate a reliable 'composite' conversion rate, to estimate, from lending statistics, the corresponding correlated benefits m_2, m_3, ...m_j for other activities (e.g. reference) equivalent to each book borrowed. Questionnaire responses are analysed to assess whether m_1 varies significantly for adult (vis-a-vis junior) loans, for loans of expensive (vis-a-vis inexpensive) books or for specific Dewey-decimal non-fiction or for fiction categories inter se. Thus, questionnaire, observation, secondary data from library reports and other data sources are analysed to assess the extent to which:

(i) an 'expected value' can be assigned to each bookloan (m_1)
(ii) bookloans are sufficient as estimators of 'total' activity of libraries that the benefits of all 'book' functions may be estimated, using an augmented multiplier Σm_i;
(iii) whether m_1 and Σm_i differ significantly for different book categories; and
(iv) whether they differ significantly for different kinds of libraries.

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(6). Francis, D.P. An Investigation into the Cost-Responsiveness of Public Lending Library Issues (Master of Philosophy Thesis) The City University (London) March, 1975.

Having examined in Part I the evidence that bookloan data are reliable information for estimating the 'income' (benefits) derived by a public from library lending and correlated non-lending 'book' activities, we proceed in Parts II and III to assess respectively the 'general' and 'specific' effects of capital expenditure on bookloans. Chapter two shows from (i) librarians' reports, (ii) academic findings, (iii) historical data, (iv) data used in the earlier thesis (6) and (v) other published and primary sources, that (a) social climate (i.e. 'class' but affected by schooling) and (b) bookstock expenditure determine issue trends, but that (c) capital expenditure accounts for episodic changes in trend.

After discussing the nature and period of the sample, chapter three uses secondary data from (i) The Municipal Yearbook (7), (ii) Public Library Statistics (8) and (iii) 'Corbett' (9), corrected where necessary from primary data, to show that the variable, 'issues of books per capita' has a positively skewed frequency distribution, partly because of unequal sizes of administrative authorities. In chapter four, data from the Society of County Treasurers (10) shows that the variable, 'capital expenditure per capita' also has a positively skewed frequency distribution.

Thus, a simple linear correlation between these two variables is not useful without first assessing (i) the effect of extreme values on the coefficient and (ii) the performance of both variables over the period studied, but the latter is complicated by the high correlation between capital expenditures per capita for any pair of years in the period 1969/70 to 1973/74 because of consistent spending by some counties on long large projects.

Yet, in chapter five, even when 'extreme' per capita values (e.g. Wales and Rutland) are excluded, the correlation coefficient between capital expenditure per capita in 1969/70 (as an increment to total capital stock) and the index of increment in issues per capita (1970/71 - 1975/76) is shown to be significant despite (i) differences in frequencies and sizes of building projects; (ii) the 'non-effect' of investment in large long uncompleted libraries and (iii) the non-inclusion of capital expenditure on mobile libraries. To compensate for the limitations of linear correlation (supra) a non-linear (2 x 2) category association test was also carried out, with a positive result.

Part III considers respectively in chapters 6,7,8 and 9 the specific effects of capital expenditures on buildings, mobiles, bookstocks and 'human resources' on the issues of books within the context of the sample (English counties) but with supporting evidence from elsewhere, where necessary.

In chapter six, building projects are considered in general, and the 'building cost' component of such projects (vis-a-vis furniture, equipment, site etc. costs) in particular. The sensitivity of issues to earlier rather than period capital costs requires explanation. It is shown that this is not simply a 'lag' effect, but partly a function of the change from small 'less expensive' to fewer 'more expensive' projects during the period. Sample frequency distributions of building project costs are compiled for 1969/70 to 1970/71 from capital estimates, librarians' letters and the two publications New Library Buildings (11), verified from Public Library Statistics (8) and tests are conducted to assess the effect of increases in the frequency of service points (full-time) per capita on the issue statistic. Then, future estimated costs for new buildings at 1970/71 are compared (using earlier 'rolling programmes') with subsequent costs and developments, using New Library Buildings (11), data obtained from primary sources and from librarians' reports. By using linear correlation, and a modification of the chi-squared test, it is shown that later expenditure is more concentrated on fewer projects with less effect on the variable, issues per capita.

Chapter seven uses the mobile library frequency data in Public Library Statistics (8) to assess whether issues per capita are sensitive to the frequency of mobile libraries per capita. It is shown that 'per capita comparison' of mobile library frequencies has the disadvantage that, as mobiles are best suited to sparsely populated areas, as the report Public Library Service Points (12) evidences, the correlation coefficient between mobile library frequency and population size of county is not as great as that between mobile library frequency and geographical size of county. Thus, two standards of comparison must be used (i) mobile libraries per capita, and (ii) the relative frequency of mobile libraries using the difference between actual number of mobile libraries, and expected frequencies, employing a regression model based on both population and geographical size.

The differences between the ranks of counties when ranked on the bases of criteria (i) and (ii) above were shown not to be significant, and when a 2 x 2 simple category test of association between investment in mobile libraries and the increase in issues per capita (index L) was applied, the association was shown to be both positive and significant. The exceptions were then studied, and shown to be counties where there had already been a pre-existent high rate of investment in mobile libraries, where the main impact of effect had already taken place. Detailed county library reports were used at this stage.

Chapter eight considers the extent to which bookstocks should be regarded as 'capital' or 'revenue' in terms of expenditure. Models of academic and public library usage are considered. Then follows a review of the earlier work (M. Phil thesis)(6) and subsequent research (13) to assess the sensitivity of bookloans to (i) expenditure on bookstocks and (ii) quantities of bookstocks purchased in London, and the extent to which London must be regarded as a special case. The same methodology is used in respect of the sample of English counties as had previously been used (6)(13) with London, and it is shown that issues are sensitive to bookstock investment in the current sample only when bookstock acquisition is accompanied by increases in library frequencies as twin aspects of the same investment decisions. In this chapter primary data includes that obtained from a number of date-label studies at several libraries.

In chapter nine I construct several measures for the assessment of investment in 'human capital' (i.e. training) and it is shown that there is no significant effect of this class of investment within the short-term period studied. Finally, after summarising conclusions, chapter ten assesses the truth of the hypothesis, and its usefulness for library investment.

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(7). Municipal Journal: Municipal Yearbook (annual).
(8). S.C.T./C.I.P.F.A.: Public Library Statistics (annual).
(9). Corbett, E.V. (ed). The Libraries, Museums and Art Galleries' Yearbook (James Clarke & Co. Ltd. Cambridge, 3 eds 1965-71).
(10). Society of County Treasurers: Capital Expenditure Statistics (an)
(11). Ward, H(ed) New Library Buildings (Library Association 1974-6).
(12). Library Advisory Councils (England and Wales) Public Library Service Points (H.M.S.O. London, 1971).
(13). D. Pitt Francis: Cost-Benefit Analysis and Public Library Budgets (Library Review: 1976 Vol 25 No 5/6 pp.189-192).

Sources of Data, and Explanation of References

(i) Sources of Data

These are primary and secondary. The main source of primary data for Part I consists of responses to the questionnaire. Respondents were geographically widespread, so that data would not reflect library readership bias of any particular area. Primary data also includes (a) contemporary frequency-counts of people and book-issues at libraries using the method of pp.39-40; (b) date-label studies for assessing usage of depreciating bookstocks (chapter 9); and (c) librarians' responses (letters) to information requests (i) in 1973-5 for the earlier thesis (6); (ii) in 1976 for details of capital expenditure on libraries; and (iii) in 1977 for completion costs of particular county library projects. These authorities are listed in acknowledgements (ix) para 7. but some respondents have since been incorporated into larger authorities.

Secondary data consisted, (inter alia) of (a) the capital estimates of library authorities, (b) the long-term 'rolling' programmes of county councils, (c) many librarians' reports for detailed information, (d) official statistical sources, such as (i) The Municipal Yearbook (7), (ii) Public Library Statistics (8), the 'Corbett' library yearbooks (9), Capital Expenditure Statistics (10), editions of New Library Buildings (11), D.E.S. publications and reports of Library Advisory Councils (12), and (e) academic reports, research papers and other sources listed in the Bibliography (pp. 382-5).

The main analytical techniques were (a) the calculation of correlation and regression coefficients for testing linear association, (b) the use of non-parametric tests (e.g. adaptations of the 'median' test and rank correlation coefficient) for non-linear correlation, (c) calculation of coefficients of variation and frequency distribution models, and (d) F-tests and analysis of covariance in multiple regression analysis. Though the Durbin-Watson statistic was used to test autocorrelatio the main cases are evident from correlated paired observations of a variable for pairs of years (e.g. t, t + 1).

(ii). Explanation of References

There are two footnote sequences. To avoid the confusion of two numbering systems, a number (e.g. 12) denotes a bibliographical reference, while number and letter (e.g 37a) an explanatory note.

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(8). A large number of respondents to questionnaires and participants in interviews.

Some of the library authorities listed above have subsequently been absorbed by County and Metropolitan Councils, but the data concerned were specifically obtained from the areas mentioned, and subsequent data from the absorbing library authority.

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PART I. THE MEASUREMENT OF SOCIAL BENEFIT

Chapter One. The Problem of Estimating the Financial Values of the Social Benefits from Library Investment

1.1 Introduction

This chapter constitutes Part I of this thesis. It is concerned whether, in the specific case of public libraries, there is need to aggregate the estimated values of benefits from each of a library system's 'book' and 'non-book' activities. Studies of cost-benefit analysis procedures for academic (i.e. university libraries) have shown that there is considerable inter-library variation (i.e. lack of correlation) in lending, reference, information and other functional activities, but it is argued that public libraries are more homogeneous and their activities have higher positive correlation with each other.

The chapter considers the alternatives for the valuation of benefits, that of regarding each service unit (i.e. bookloan or reference volume consulted) as having the present value of all discounted future benefits which a reader ultimately obtains from the service unit, and that of assigning an expected value to the immediate benefit which the reader derives from the service unit.

It proceeds to review the case for using a conversion factor for the estimation of benefits from the lending function, using the statistics of lending library issues, and discusses the extent to which lending library issues may be a powerful estimator of the activity of the public library system as a whole, in all its functions (i) because of the relative size of the function; and (ii) because of the correlation of lending library usage with all other 'book' activities of the library.

The case is developed using (i) the evidence from a pilot questionnaire, used in connection with the earlier thesis (6); (ii) the responses from a larger sample survey, not only intended to be a longitudinal study but with inbuilt checks to test the validity of responses; (iii) evidence of the valuation of equivalent sources of reading (e.g. newspapers, second-hand books, commercial library subscriptions and other equivalent information); (iv) observation data relating to the correlation between lending and other activities using sample observations from 10 libraries frequented by the researcher for a statistically valid number of times and 50 other libraries throughout the United Kingdom visited during the period of research and (v) secondary data in reports and letters from county and other public librarians.

The analysis of this data is intended to resolve the questions whether:

(i) a reliable expected value can be assigned to a bookloan;

(ii) book-lending correlates with other recorded and unrecorded library activities, such that it may be a reliable estimator of total activity and benefit; and whether

(iii) an 'aggregate' conversion factor may be used to convert library loans into estimates of aggregate total benefit, different aggregate conversion factors being used when some functional activities are absent, as in the case of mobile libraries; and whether

(iv) the expected value of loans differs significantly for different types, Dewey-decimal classifications and prices of book.

The resolution of these questions is essential to any attempt which may be made to estimate the social income from a library system for any one year. It is recognised that income estimates obtained by such procedures are limited in usage because of changing tastes. The question is whether they are reliable compared with other estimates used for model-building in commerce and in the public services.

(6). D. Pitt Francis: An Investigation into the Cost - Responsiveness of Public Lending Library Issues Master of Philosophy Thesis. T.C.U. March 1975.

See abstract and research statement for notes 1 to 13.

1.2. The problem of estimating social benefits from libraries.

(i). Immediate and Ultimate Valuation Criteria.

In basic financial project appraisal income statistics are used to test the efficiency of capital investment. A project is said to be viable if its discounted net receipts have a greater present value than outgoings on the project. The methods of comparing outlay with income involve either the computation of the project's net present value at a given cost of capital or the calculation of an internal rate of return on the project. If the net present value is positive, or if the internal rate of return is greater than the cost of capital the project is said to be viable. 'Payback' is inapplicable to non-charging, public services.

Many of the capital expenditures and income benefits of operations in the public sector are not readily quantifiable. For example, the capital expenditures of a hospital may not only consist of the actual labour and materials used in its construction, but the opportunity cost of publicly-owned land on which it is built. Similarly, the income of a housing project must not only include the actual rent received by a housing authority but the social benefit derived by tenants in terms of the opportunity costs of alternative housing wherever this is possible.

Yet, in both the above cases, the quantifiable and unquantifiable proportions of capital outlay and income benefits form significant proportions of total outlay and income respectively. But in some sectors of public expenditure, the unquantifiable nature of the benefit derived by a public forms such a large proportion of total benefit, that any tangible or readily quantifiable benefit appears insignificant in proportion to it. Benefits from the hospital service, from education and from libraries come into this category. They must be estimated, and two methods of valuation may be suggested. They are not simple category alternatives but polarise a spectrum of possible intermediate bases of valuation. The first is to use an 'ultimate' concept of valuation: the second is to use an immediate one.

For example, the benefits of a hospital service cannot be valued exactly in financial terms. The benefit to the public, or to individual components of it, may be judged to be either:

(a) the ultimate value of public health as a social investment; or

(b) the aggregate of the values which each patient (and others inconvenienced indirectly by illness) would be prepared to pay for treatment if there were no State-owned hospitals.

The first measure is impossible to quantify with precision because of the large number of variables which may affect it in a time-continuum and because of the difficulty of arriving at an appropriate time horizon from which individual and collective benefits may be discounted. The second measure is a viable one for capital decision-making purposes, but it is not ideal because of the changing nature of valuation.

The provision of a library service involves, in one (13a) of its objectives, the continuous education of individual readers, and the problems which both the library and education services generate in respect of the estimation of their benefits are similar to those which have been presented in the case of hospitals, and similar to each other. The financial outlay on libraries is only a small proportion of the real outlay in many cases, and the returns on investment which cannot be accurately quantified are disproportionately large compared with those which can be so quantified.

This problem is not peculiar to libraries. In the case of State schools there is usually no financial income as such, for receipts from auxiliary services such as school meals are merely a contribution to subsidised

(13a). Education and information may be regarded as the 'capital' or investment content of library usage, while leisure and enjoyment may be regarded as 'consumption', but even this is not a clear dichotomy cost, and there are in some cases rents payable for school premises by outside organizations.

The social income of a school may be estimated either by aggregating and obtaining the net present value of a stream of benefits which education will provide to the school's students and others in society over an appropriate time-horizon or by aggregating the opportunity costs for each child or parent concerned, that which each parent would be prepared to pay for such education if he could afford it.

As in the case of the hospital the first measure of value is less quantifiable than the second, because the present value of an educative process extended over time horizon t_1 may be different from that extended over time horizon t_2, while the second measure is quantifiable but less satisfactory because people in lower income categories may not be able to pay the hospital or school fees as the case may be.

Yet, the first measure of valuation of the educative process has its advocates. The question is whether such a measure can be applied to library usage. For example, G.S.Becker (14) succeeded in deriving rates of return for various types of American schooling. Becker showed that if a satisfactory social 'cost of capital' is applied to the incremental earnings which the education process opened to the groups of graduates which were studied in his researches, the values of each year's income in the educative process may be derived as a set of successive 'present values' and the net profit of the school system for any particular year is derived as the 'present value' of relevant future benefits from a particular year's education less the educational costs of that year.

(14) Becker, G.S: Human Capital (National Bureau of Economic Research, Washington) 1965.

Becker's model shows us how to proceed if we wish to apply such a methodology to library benefit valuation. But it exposes the impracticability of such an application. For Becker's criterion is a comparative one. It derives, by empirical means, the added benefit of university education in comparison with 'high school' education. But, for example, it is able to compare two contrasting systems which operate for students in the same area. In the case of public libraries, one library authority operates each area, so that there are no alternatives for which costs and benefits may be compared.

It is, of course, possible to assess the comparative effects of different library authorities on undergraduates from different parts of the United Kingdom prior to commencing a particular degree course, and rank or value the performance of library authorities accordingly. A similar study was made by R.D.Walker for the University of Illinois (15). But such a study would only value library systems from the standpoint of one age-level of readership and be inferior to the method which has been devised in this thesis.

The second reason why Becker's method cannot be applied to library services is that the library contribution to educational development as an investment is much smaller than that of direct education (schooling) and therefore considerably less easy to identify. Education constitutes a large proportion of Government aided (Rate-support Grant) local authority expenditure, varying between 50% and 60%, (16) but library services are a comparatively small variable, both in respect of Government expenditure (less than 5%) and in respect of public usage.

These two factors make the methodology of Becker (14), Blaug(17), Sheehan (18) and Vaizey (19) difficult of application to

(15). Walker, R.D. The influence of antecedent library service upon academic achievement of university of Illinois freshmen (University of Illinois:1963)

(16). R.S.G.Increase Orders and White Papers (HMSO,1970-1976).

(17). Blaug M.(ed). Economics of Education (Pergamon:1970).

(18). Sheehan, J. Economics of Education: Studies in Education (Allen & Unwin:1974) libraries. It is not possible to compare (as with Becker's school systems) the effect of competing systems on identical populations and the library contribution to education cannot be factor-isolated from other contributing factors to education, as can that of a school system. To illustrate the second problem, library usage is one of many variables associated with education, such as the effect of radio, television, purchased books and other media, all of which affect education and personal development. The normal statistical method of isolating these variables would be by factor analysis, but in this case my empirical studies, using analysed data from questions 3 and 4 of the questionnaire, which is described in Tables 2-7 and from interviews and discussions with library readers about their use of other media, showed that the great majority of people who used and benefited from public libraries were also (i) in receipt of full-time or part-time education, with the small exception of the 'pensioner' category listed as "(f) other" in the questionnaire; or (ii) had private book collections and took regular newspapers; or (iii) listened to educational programmes on radio or watched them on television for a significant proportion of their time. It was discovered that, with the exception of television watching, to the extent that it is competitive with, rather than complementary to reading, there was a high correlation between the contributory factors. For example, full-time students tended to have higher public library and academic library usage than others.

Thus, the process of isolating the 'library effect' for each sample individual becomes virtually impossible even at this stage of the argument. It also requires the summation of the long-term effect of library usage on income (employing Becker's methodology), then the expression of this long-term effect as a present value, for each year of library usage for each individual.

(19). Vaizey, J. The Economics of Education (Studies in Education: Macmillan, 1973).
Vaizey J. & Sheehan J. Resources for Education (Allen & Unwin: 1968 et seq).

At this stage the impossibility of the process becomes obvious, for it involves the calculation of a present value of aggregate individual benefits to all library users at t_0 but this would not necessarily be of identical value with the group benefit provided by (*) a library to a population at t_0. In the case of schools, students at a particular type of school can be classified and their careers studied long afterwards. Thus, the benefits of a particular group of years' tuition can be estimated by enumerating the students, assessing the opportunity cost of increased incomes which result from attendance at the school and expressing these benefits as a present value at t_0.

But library users cannot be so identified and studied so easily for the remainders of their lives because:
(i) library readers are mobile and may move several times from one library system to another in the course of their lives, so that the follow-through effect used for the cost-benefit evaluation of education systems cannot be assessed for libraries;
(ii) there is inter-change particularly where the tickets of commuters are used in library systems other than those issuing the tickets;
(iii) higher education is pursued away from the home environment and the resident in the area operated by one library system may disproportionately benefit from that operating in another area;
(iv) library usage may not be as evenly lag-distributed over a series of years as a course of full-time or part-time education; and because particularly
(v) library users' records are not retained sufficiently long afterwards, so that the aggregate of a population of library users cannot be studied for years t_1 to t_n to estimate the value of their library usage in t_0 as benefits provided for the rest of their lives.

(*) including externalities and non-user benefits, which would have to be considered if an 'ultimate', composite approach to the problem were adopted.

(ii) An approach to valuation using immediate opportunity cost

If we abandon the search for a method of measuring the ultimate benefit which a community is likely to derive from all aspects of a library service considered as an investment of aggregate users and readers time, the search for an 'immediate' method of valuation of benefits must recognise that it can, at best, be an estimate. Not only are the activities (i) borrowing and reading, (ii) browsing, (iii) information searching; (iv) newspaper and periodical reading and (v) non-book (i.e. cultural) activities distinctly different from each other, but each piece of information, each book, each reader or group of readers and each time-interval in which the piece of information is obtained or the book consulted in or out of the library is distinctly different also. Thus, if we wished to adopt a completely analytical approach to library usage valuation (i.e. distinguishing lending from reference usage) it would be necessary to regard each usage as a special case in itself, and the very aggregation of non-identities would render the process both impossible and meaningless.

But, if, conversely, it is recognised that any measurement of library activity can, at best, produce an estimate of benefit, then there is a case for searching for a variable which will measure, at a good statistical confidence level, all aspects of library activity and to which a conversion rate can be applied for the purpose of estimating the annual income or social benefit derived from the system as a whole. If, for example, the number of issues of books per annum, issued by the system's lending library is selected as the variable from which the system's activity may be assessed, because (i) lending satisfies the largest number of objectives of the library system; (ii) the lending function is disproportionately large compared with other functions and (iii) the lending function is significantly correlated to the activities of all other functions, then the process of unnecessary analysis can be reduced even further. Library systems can be judged by a simple estimation from library issues as activity indicators, using a 'conversion rate' for each type of library involved, so that all other functions are taken into account in assessing total benefit (or social income).

Before we move to attempt the compilation of such a conversion (or translation) system, it must again be stressed that, for the reasons which have been given (i) the fact that lending is a disproportionately large activity in relative size with other activities; (ii) the correlation between lending and all other activities; and (iii) the total (non-analytical) nature of library objectives, it is neither (i) compatible with the objectives of Public Libraries as stated by the Public Library Act or (20) (ii) in other statements of objectives (21) that one should analyse each functional activity so that, for example, the reference function may be increased if its benefit/cost ratio is found to be greater than that of the lending function. Any attempt to value the benefit of the library system must examine an activity which is typical of the library system as a whole and use a conversion factor which incorporates the benefits receivable from functions other than the representative function.

It is the failure to realise that such a conversion can be statistically valid which has deterred cost-benefit studies in libraries. In this context it is useful to examine arguments put forward by Alan Pritchard in a paper presented at the City University in December 1973 (22).

Pritchard attempts to apply management ratios, such as those used to measure the achievement of objectives in industry and commerce in terms of sales, market share and profit, to libraries, and shows that some ratios have no direct analogy in library management.

For example, he puts forward the argument that some ratios are not applicable, and questions the worthwhileness of 'an attempt to value the 'social profit' of a library'. Yet, he concedes that 'it might be possible to allot some form of arbitrary value to a loan of a book or to a reference question asked and use these as indicators over a period of years (not forgetting inflation)' (23).

There is no conflict between his opinions and the methodology which I shall be proposing later. He recognises the global (or total) nature of the general objectives of libraries, such as 'to implement the provisions of the Public Libraries and Museums Act; to increase stock effectiveness by improving the speed of the supply of any book; and to ensure that all materials are forwarded to departments as quickly as possible' (24).

Yet the very objectives which he states must militate against a desire to be over-analytical, to analyse the service into such functions as lending and information provision, to extend the most 'socially profitable' at the expense of others. His reservations about the estimation of social profit (except by using 'arbitrary' conversion factors for loans of books and reference library usage) spring from an attempt to be non-global non-holistic, and functionally analytical in assuming, for example, that the proportion of reference library usage to lending library usage differs more significantly (as an inter-class comparison) between one library and another than do the activities of the libraries themselves differ from each other as a whole (as an intra-class comparison).

It is true that any individual valuation of the loan of a book may be 'arbitrary', but it is argued in this thesis that the extent of 'arbitrariness' may be empirically determined. Every value is to some extent arbitrary. Changes in commodity and share

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20. The Public Libraries and Museums Act (1964) (HMSO).

21. Committee under H.T.Bourdillon C.M.G. Standards of Public Library Service in England and Wales (HMSO 1962). Statement of Public Library Aims and Objectives (Library Association Record, 73 (12) December 1971).

prices pose limitations to their uses for management, both in terms of 'monetary' and 'real' pounds, yet they are repeatedly used by management for decision, valuation and cost-benefit purposes. There is an arbitrariness about some methods used by accountants to calculate the income of firms.

But if it is the case that the statistics of loans of books relates to such a relatively large library function that it can be used as a safe estimator of activity and benefit irrespective of whether it is correlated with other functions, and if it can also be shown that there is such a correlation, then we need not be too concerned about Pritchard's later reservations about measuring 'sales ratios' in the context not only of bookloans, but of 'issues, enquiries, people visited at home' (25) any more than manufacturers may be concerned about the 'windfall' effect of by-products in making very small accretions to an already existent large sales revenue from its major product, and if the by-products production can be estimated from the production of the main product, and there are methods of estimating the value of the by-product, then the units of the main product may be used not only to estimate the sales revenue and profit from the main product, but an 'absorportion' value which includes all by-product activity may be added to the conversion rate, in order to estimate the aggregate sales revenue and profit from both the main product and by-products.

Thus, while Pritchard abandons library equivalents of accounting profit ratios to explore marketing management ratio equivalents in library management, using market share, such as $\frac{\text{number of registered readers using service}}{\text{total catchment population}}$

22. Pritchard, A. The Library as an Industrial Firm: An Approach to Library Management (T.C.U. unpublished 12/1973)

23. op cit p.7. 24. op cit p.6. 25 op cit pp7-8

this thesis moves to explore the area which Pritchard left unexplored. The 'main product' aspect of library loans was partly explored in the earlier thesis on revenue aspects of library services (12) but in that thesis I proposed a specific rather than a general usage of library loan statistics.

It is recognised that it is impossible to 'generalise' library performance absolutely, because there is no correlation between some of the non-book activities of libraries and their lending function, and because these activities vary from each other, and from one library system to another. Luckham (26) details these activities as lectures, film shows, gramophone recitals, sponsored societies, play and poetry reading, art and general exhibitions, group visits, concerts, drama, adult classes, discussion and reading groups, arts festivals, clubs and councils, film making and the letting of rooms.

But many of these activities which he lists can be paying activities (or participant financing activities) in their own right, and so need not be included in our model.

The argument that we can obtain readers' estimates of expected values from reading a book, add the proportionate expected values of all other related services and multiply by the number of issues by a lending library in order to obtain the total annual benefit derived from a particular library requires to be supported against the charge of 'arbitrariness', and we must do so by questioning whether such a method of proceeding is more arbitrary than that which is usual for accounting income.

In accounting valuation models, the point of sales of goods and the receipt of accounting income becomes a 'cut off' point for measuring whether an investment is worthwhile. The question whether, in ultimate terms, each sale has the value indicated by the transaction, is rarely considered, and is often regarded as irrelevant to such income models. Generally speaking, the extent to which sales may be detrimental to a purchaser is one for his own personal judgement. Commercially retailed products have consistent market values at any given time irrespective of their individual effects on particular purchasers (In practice, these theoretical assumptions are usually modified).

Some may have ex-post negative effects. The effects of the sale of faulty automobiles, or the provision of excess meals or overdosing by valuable drugs on particular individuals must, for example, be considered quite apart from the commercial values of such products. In this particular respect all commercial values are arbitrary, and result from market forces which themselves result from subjective opinions about value. Yet commercial capital investment models invariably use income statistics which are themselves derived from expected commercial prices which are derived from subjective opinions about value. If the use of questionnaire-based surveys can produce 'expected values' of the modal library loan, which are more stable than commercial commodity prices and tested by methods which are statistically powerful, there is every reason to think that library capital investment models which use such values of expected income are even more valid than those used by accountants.

(iii). Approaches to the valuation of immediate benefits

Thus, we shall be confined in this thesis to an attempt to value the 'social income' of a public library or system of public libraries in terms of its 'book' activities, and shall exclude the smaller

(26). Luckham, B. The Library in Society (Library Association 1971).

non-homogeneous activities described as 'non-book' by Luckham (26). Having achieved functional homogeneity , by confining this study to functions undertaken by all (or nearly all) United Kingdom library systems, we can then adopt two possible approaches:

(i) we can select a statistically representative and large sample, consisting of library members (i.e. those with readers' tickets) and ask each in turn for annual estimates of the value of the public library service. The aggregate value of the estimates in the sample can then be multiplied by a factor representing the relative magnitude of the population size to the sample size; or

(ii) we can choose a major activity, such as the issue of books, and assess whether it is a valid statistical indicator of the performance of the library system as a whole, then multiply it by a factor which includes not only readers' estimate of the expected value of a bookloan, but an estimate of the proportionate value of all other related library services.

The relative merits of these two approaches can be assessed using the same criteria as that for a commercial system. An ideal ultimate valuation of benefits would require consideration of the activity of the library system. Although we have rejected this course as impracticable it would have involved theoretically the multiplication of each library activity by a 'present value' representing the aggregate of all future benefits derivable singly and jointly from each activity. The use of alternative (i) moves to another extreme for it adopts a position which does not take account of library activity at all. It relies on subjective estimates of the opportunity of having a library, irrespective of whether the member-estimator used it at all. Although the method has been partly adopted in the questionnaire for the purpose of obtaining readers' estimates of the annual value of (a) the reference library service and (b) the inter-library loan service, it was abandoned at an early stage as a good means of estimating the total value of annual benefits of a library system to its readers, for it was discovered, for example, that wealthy readers were apt to impute larger annual values to the benefit they derived from the service, though their usage may be much more casual than that of non-wealthy regular readers.

We are thus made to consider the second alternative. Its validity rests on the question whether the most popular measure of library activity, the lending library issue statistic is a valid measure of the total activity of the library system, such that it can be used as an estimator of the benefit derived from that system as a whole. This can only be the case if (i) the lending function satisfies most of the corporate objectives of the library system; (ii) the lending function is so relatively large compared with all other functions that it occupies a position analogous to that of a dominant (or main) product in a commercial undertaking; and if (iii) the lending function is so highly correlated to all other functions that an aggregate factor may be used for the conversion of annual issue statistics to total annual benefits. In the next section of the chapter I shall examine these arguments in turn.

1.3. The case for using library loan statistics to estimate benefits

(i). The corporate and 'total' nature of library objectives

From the previous sections of this chapter we may deduce that it is relatively easy to obtain empirical estimates of the modal value of the loan of a book, multiply the grand mean of such estimates by a public library's annual issue statistics and estimate the total benefit which the system derived from lending books during the particular year. A pilot study undertaken in connection with the earlier thesis (12) did so. Subsequent research has improved the methodology for the valuation of lending library benefit by obtaining:

(i) current estimates of the amounts which would be charged by commercial libraries, taking inflation into account;

(ii) methods of calculating royalties payable to authors on behalf of library usage, (public lending right);

(iii) prices which readers are prepared to pay for 'throw-away' literature, such as newspapers and periodicals which are read once and then disposed of;

(iv) costs of second-hand books less their disposal values; and

(v) the percentage of the value of a book which a sample of readers considers to be its 'information' benefit

An improved questionnaire has sought to assess whether loan-values are sensitive to (i) the nature of the book (i.e. fiction or non-fiction); (ii) the nature of the loan (i.e. adult or child); (iii) the subject matter of the books (indicated partly, though arbitrarily, by its Dewey-decimal classification); (iv) the cost of the book; or even to (v) the nature of the reader (regular or casual) and to validate the information even further by three methods of estimation (i) asking the reader for an approximate indication of the value of a bookloan; (ii) asking a reader for an approximate estimate of annual library benefit and of the annual number of books read, and then dividing the one estimate by the other; and (iii) asking the same reader for an estimate of the value of the loan of a book as a percentage of its commercial value, and then asking (elsewhere on the questionnaire) for the normal commercial value of books borrowed from the public library, so that the average 'loan-value' of a book borrowed may be derived by this method also.

However, the question with which this thesis must be concerned is whether we may proceed further, and having already decided that the benefits of the lending function can be obtained successfully by the multiplication of empirically derived values, then increase the conversion factor to include all other associated benefits.

The primary justification for doing so is that all public library functions are inseparable, and that therefore all are necessary in the achievement of the corporate objectives with which libraries are charged, and that library activity should be therefore measured as a 'total' activity rather than as a composite of dissimilar activities. Different statements of library objectives have been associated with the Public Libraries and Museums Act (20), the Bourdillon committee report (21) and the Library Association (21). That of the Bourdillon committee is probably the most comprehensive. It states that the system should be (i) developed as a national asset; (ii) provide an adequate service for all readers despite population differences; (iii) provide a wide range of books and related material for use at home and in the library itself; (iv) provide access to books not in the compass of the library's own stock; (v) effect a balanced distribution of titles including children's books; (vi) run an adequate information service; (vii) liaise with colleges (and now polytechnics) to avoid the duplication of scientific and technical material and (viii) achieve miscellaneous objectives such as the provision of a cultural base and of space in which to study. It is in the nature of things that the achievement of these objectives must be balanced, and we may therefore expect them to be highly correlated, so that while no librarian would wish to maximise loans of books as such, for it is not regarded by the library profession as a desirable objective in itself, we may conclude that if there is no conscious attempt to maximise loans and if the system is balanced, the loan statistic should provide us with a reliable measure of the system as a whole.

In this respect the comparison of public library systems is both different and easier than that of academic libraries. Public libraries are charged to pursue policies consistent with the above objectives and to provide for statistically homogeneous populations in different geographical areas. Academic libraries are charged with policies related to the objectives of differing universities.

Baumol and Marcus (27) have shown that there are dissimilar costs and cost trends in small specialist academic libraries, compared with large undergraduate public university libraries, and it is evident that these differences must be associated with the differences between the corporate objectives of such institutions.

(27) Op cit (4), pp.78-79

University libraries are different from public libraries because the user needs are less homogeneous. Raffel and Shishko (28) listed three distinct objectives and programs for the Massachusetts Institute of Technology libraries (i) to provide a general and research collection; (ii) to provide required reading and facilities for studying; and (iii) research and development. The extent to which academic libraries satisfy these objectives, and the proportions of their budgets which are expended satisfying these needs depend to some extent on whether the university or academic institution does undergraduate or postgraduate work, and the extent to which students are resident or non-resident. These variables are evident in the Raffel and Shishko study itself, where reader-space budgets are determined by (i) dormitory reading and (ii) other reading space provision.

Further, because each academic library can satisfy its own objectives some inter-objective analysis is possible. Public libraries are quite different. They are charged with satisfying the objectives of the Public Libraries and Museums Act, the Bourdillon (20) committee report and the Library Association's own (21) statement of public library objectives. These are corporate and integrated and do not differ from one library authority to another.

Thus, unlike the case of university libraries, we have to consider the extent to which each library function satisfies the corporate objectives of public libraries as a whole, and it is in this respect that the lending activity provides the best criterion of total library activity. So we refer again to the Bourdillon committee's statement of objectives given above.

Let us elaborate by considering each in turn.

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(28) Op cit (5) above. pp 4 and 9.

Objective (i) requires the development of the library system as a national asset. At least 90% of this asset, when measured in terms of bookstocks, consists of lending library books, (29) (30). Further, the staffing provision of lending departments is over 90% of that of total library staffing provision in many cases.(31). My own studies of stock replacement rates, using the statistics of a large sample of libraries (32) indicated that the rate of replacement of lending library bookstocks is greater than that for reference stocks, with the exception of some open shelf reference material. With respect to objective (ii), that of providing a service to all readers despite population differences, it must be stated that lending libraries can satisfy the criterion of provision for sparsely populated districts, by means of mobile libraries, whereas reference libraries do so to a lesser extent. Further, my own observation studies at four central reference libraries and at twelve smaller libraries which had reference departments indicated that there is greater representativeness of the whole population in lending library users rather than in reference library users. This does not contradict the fact that all age groups and most occupation categories may use both, but the proportion of students and professional people using reference libraries is significantly greater than that of those using lending libraries. (29a).

Objective (iii) is better measured by lending library activity data than by reference library data because the provision of books for lending libraries is significantly greater than that for reference libraries in the public library system. We shall show that the reverse is true in the case of academic libraries.

(29a). See also, inter alia, Tables 3 to 7, and 9.

Objective (iv) is the specific inter-library objective. It cannot be measured by the lending library issue statistic alone, and it is a non-integrated, specific, easily measurable function, unlike the other objectives which are considered in this section of the chapter. Yet, I shall show later that the inter-library function (30a) is correlated to the lending function, and that the activity of the inter-library loan function can be easily estimated from the statistics of the lending library issue function. Similarly objective (v) relates more specifically to lending than to any other function and although (vi) is a reference rather than a lending objective, it relates to the provision of information measurable outside the statistics of normal usage of a reference service.

As in the case of objective (i), objective (vii) is satisfied to a larger extent by the lending rather than the reference function and only objective (viii) comes entirely outside the scope of measurability by means of data of the lending function.

We can thus conclude, before considering the other two reasons for lending library statistics as an estimator of total library activity, that (i) library authorities which provide services for the general public have user needs which are much more homogeneous than academic libraries , and their objectives require that their activity should be measured as a whole, rather than being subject to functional analysis; (ii) academic libraries differ from each other in the extent to which each objective must be satisfied, and an analytical non-corporate approach to objectives is thus necessary in the case of university libraries, while in the case of the public library systems there should be a balanced relationship between all objectives, and each should not be more important for one system than for another; and (iii) the lending library function statistics provide a measure of the extent to which most of these objectives are satisfied.

(29). Library Association Reference, Special and Information Section: Reference Library Stocks (L.A.1960)

(30a). But not in exceptional circumstances (e.g. Buckinghamshire) where book purchase restriction activated inter-library loans.

(ii). The relative size of the lending function

The argument of relative size has been discussed in the previous section. It is that, as the lending library function is proportionately the largest of all library activities, it is the best index of total library activity. Again, it must be stressed that library functions are not being regarded as competitive, but as complementary to each other. The question is, in the context of complementarity, which function forms the largest ingredient in the total mass of activities.

It has already been stated that over 90% of books in library bookstocks are in lending departments, and that in many cases 90% of staffs are employed in lending departments, particularly in large and central libraries. The situation in respect of stock and staffing provision has been consistent over the past 17 years (29),(30),(31).

But the lending function is not only the largest in respect of stock and staffing provision. It is also the largest from the standpoint of usage. Other, earlier empirical studies showed that, while 83% of people who visited libraries did so to borrow books for themselves and 28.5% did so to borrow books for others, only 17% visited libraries to consult reference material and only 19% did so to consult staff and even less to consult other sources, (33). Later studies have produced percentages which are consistent with these, and do not produce results which are significantly different at the 1% critical level of significance (34).

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(30). Society of County Treasurers and Chartered Institute of Public Finance and Accountancy: Public Library Statistics (years 1965 - 1977). The ratios between reference and lending library provisions for all years for all public library authorities is consistent with this statement and with the earlier information given by the Library Association

(31). Library Association Reference Special and Information Section: Reference Library Staffs (Library Association,1962).

The matter was pursued further by using questionnaire methods, interviews and observations at a statistically large sample of libraries administered by different authorities. Answers to questionnaires showed that whereas most people are prepared to pay only £1 per annum (or less) for the benefit of having access to a reference library, the popular valuation of a bookloan from a lending library was near 35p, and the average annual value popularly estimated to accrue from the service of a lending library, ranged between £7. 50p and £12 per annum. Thus, the popular valuation of the benefits received from the services of the two functions bore some resemblance to a 90%/10% lending/reference usage-benefit ratio.

A further argument in favour of the relative size of the lending function is that,when respondents to to questionnaires were subsequently interviewed about the average time (usually less than an hour) spent at each visit to the library, most stated that over 75% of time was actually spent in the lending departmants of the library visited.

A sixth argument relates to benefit-effect measured in terms of usage. When it is considered that each reference library is used for a modal period of less than half-an hour (35) while each lending library issue (loan) spans a proportion of the reader's spare time between two days and a month (or even longer), and that whereas only a small section of a reference book is usually read when it is consulted

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(32). Library statistics provided by the London Boroughs of Havering, Croydon, Camden and Waltham Forest, the boroughs of Bristol, Cardiff and Luton (prior to reorganisation), the county councils of Oxfordshire, Lincolnshire (Lindsey and Holland), Flintshire, and general studies from Public Library statistics testing acquisitions against stock numbers for lending and reference libraries respectively.

(33). Luckham, B. The Library in Society (The Library Association 1972) pp. 62-63, Table 40

(34). My own study counts of frequencies and proportions of readers in lending reference and other departments of 12 Hertfordshire and London libraries are consistent with these values.

while a larger proportion of lending library books are borrowed, not simply to be consulted, but to be read completely, the proportion of reference library usage to lending library usage diminishes considerably.

There is considerable evidence for the 'proportion' argument from primary data which were collected for the current thesis. Except in a few central libraries (35) which I examined in considerable detail, the numbers of people in lending libraries at any given time were usually more than those reading in the adjoining reference libraries, and even when the central reference libraries were full of people (as my observations of the Cardiff (Hayes) Central Reference Library and the St. Pancras (Camden) Central Reference Library showed), sample statistics indicated that over 30% of users were not using or reading reference library material.

Thus the argument of relative size is supported by (i) usage of books and sizes and replacement ratios of bookstocks; (ii) employment of staff; (iii) documented and empirical studies of usage; (iv) readers' evaluations of the relative annual benefits derived from lending and reference functions; (v) readers' assessments of relative usage of both functions; (vi) relative lengths of reading time, including the usage of loaned books away from the library and the fact that (vii) reference libraries are sometimes used to provide study space rather than information.

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(35) Of a large number of recorded observations made at the libraries of Old Cross - Hertford, Ponders End - Enfield, five other branch libraries, Enfield Central, St. Pancras, Camden and the Hayes (Cardiff) and other central libraries between 1971 and 1977 most frequency counts were consistent with the 75%/25% lending/reference frequency ratio except where students were simply using central reference library space (see above).

It is stressed that these arguments are not intended to diminish the importance of the reference function. The question is whether the lending function occupies a sufficiently large proportion of resources, time and cost, has a sufficiently high relative usage frequency and is considered by a sample 'public' to provide such a high proportion of the total benefit which it derives from the library system, that an index of lending library activity may be substituted for an index of the total system.

Two analogies may be offered at this stage, to pursue the Pritchard models of the library as an industrial firm (13). The first is that of a large commercial firm which markets (i) a major product L which may be consumed anywhere and (ii) a highly specialised by-product R which is produced in small quantities and must be consumed on the firm's premises. Product R (analogous to the reference function) may be as essential for the company's existence as product L (analogous to the lending function). The question is not whether they are equally important as products, but whether the performance of product L can be taken as a valid statistical indicator of the performance of both L and R. In commercial profit assessments, even though the firm had not been charged with balance between the two functions of producing L and R, there would be no doubt that if L used 90% of resources and produced over 90% of benefit a management consultant would regard L as a sufficient statistical indicator of the total system unless the production of R was sufficiently poor to reduce the goodwill of the commercial firm.

The second analogy derives from the public sector. A hospital such as Moorfields Eye Hospital provides selective treatment to a comparatively small number of inpatients, but more general treatment to an overwhelmingly large number of outpatients. Again, both services are essential, and the maintenance of balance between them is necessary, but if benefits are evaluated quantitatively the large outpatient department (analogous to the lending library) is a much better indicator of total benefits than the small inpatient department.

This analogy is not inapposite. The Library Association's early studies showed that in 77% of library systems between 5% and 20% of the bookfund was devoted to reference libraries (29) but the mode was 10%, and that only 10% of employees' salaries was specifically devoted to reference departments (31). My own studies (30) indicated that, since the passing of the Local Government Act of 1972, with the emergence of larger library systems and the greater centralization of large reference libraries, the proportion of inputs and outputs of reference libraries is even less. They indicate that less than 10% of book-costs, less than 5% of book-acquisitions and less than 2% of book-usage is attributable to reference libraries.

(iii) The correlation between lending and other functions

The use of the statistics of lending libraries as a measure of total library activity would be justifiable even if lending library statistics did not correlate significantly with other activities because of the relative size of the lending function, and because of the way in which the lending function satisfies a larger number of library objectives than any other function. But if there is such balance between lending and all other functions that correlation between the lending function activity and all other library activities is highly significant , then the first part of the composite hypothesis, that lending library issues are a valid statistical estimator of total library activity, for the purpose of estimating total library benefits and of inter-library comparison is proved on all three counts.

The correlation section of this chapter is subdivided to give details of the correlation between library issue statistics (loans) and other functional activities, using three sources of proof:
(a) detailed library and branch-library data collected from a valid sample of libraries;
(b) the correlation between questionnaire responses relating to the frequencies of individual borrowings from libraries and the extent of other library activities, thus showing that a correlation exists on a microcosmic level, using individuals as the source of variable values; and
(c) primary data collected from observations of contemporaneously collected frequencies of (i) lending library users, (ii) reference library users and (iii) lending library issues, between 1975 and 1977 in a sample of Hertfordshire and London libraries.

In all three cases the correlation between lending library issue frequencies and (i) browsing in lending libraries; (ii) interlibrary loans; (iii) reference library usage and other user activities was significant at the 5% level of significance. Let us examine each of the three sources of proof in turn.

(a): Data from Library Statistics

Some data was available for all the libraries in the system run by the London borough of Havering, for the years 1970/71, 1971/72 and 1972/3. These included for the central library at Romford and all other libraries administered by the London borough of Havering, statistics of (i) issues; (ii) books on loan on a particular date and (iii) requests for each book not possessed by the library system. As there were 10 libraries in the system and data were available for 3 years, and the effect of library size differences could be eliminated by expressing each of the above statistics in terms of (i)issues; (ii) books on loan and (iii) requests per member, there was a sample size sufficiently useful for an exploratory study. Thus there was a mean number of 2.35 books on loan per member at a given date (standard deviation 0.65, and coefficient of variation 0.28); a mean number of 37 books issued per annum to a member (standard deviation 5.72 and coefficient of variation 0.14) and mean number of requests per member of 0.48 per annum, (standard deviation 0.10 and coefficient of variation 0.21). (36)

The issue statistic is high, but it should be pointed out that the mean 'issues per member' statistic is the unweighted mean of the 10 libraries in the system If the means are weighted by membership frequencies for each library in the system, the composite mean is less because of the effect of the relatively poor issue statistics of the central library. (36)

From the data which was available it was possible to compute the correlation coefficients between (i) issues per member and books on loan to a member at a given time (to assess the consistency of the issue statistic); (ii) issues per member per annum and requests per member per annum; and (iii) books on loan to a member (as a mean) and requests per member per annum. The correlation coefficient under (i) was expectedly high (0.75) and therefore signficant at the 1% level of significance where n = 30.

But the correlation coefficients calculated under (ii) and (iii) were interesting. In the first place, if a simple rank correlation coefficient is calculated for all observation rankings in respect of (ii) issues per member and requests per member or (iii) books on loan (on average) to a member at a given time, and annual requests per member the rank correlation coefficients are respectively 0.81 and 0.78, and both of these correlation coefficients are significant. (36a).

If, however, the Pearson correlation coefficient is computed for all observations, it is surprisingly low, not because an interlibrary correlation between request statistics and issues does not exist, but because of the peculiar position of the central library in dealing with a disproportionate number of inter-library requests. This is understandable because branch library members first go to a central library to search for a book which is unavailable at a branch library, and if unable to find it make request at the central rather than at their own nearest library. Consequently, if the central library statistics are included (for the three years) the correlation coefficients are low (0.41 and 0.37 respectively), but significant because n = 30. If the central library statistics are excluded, the correlation coefficients are 0.64 and 0.62 respectively.

To avoid any assumption that these correlation coefficients resulted from inter-year variation, the inter-library variation was tested against inter-year variation, using the F-ratio test in analysis of variance, and even with the small (10 x 3) sample of observations for each of the three variables, all three F-ratios were significant at the 5% level of significance. Inter-year stability, for example, indicated small ranges of (i) between 2.27 and 2.42 for books borrowed per member at any one time; (ii)

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(36). Although these figures are unadjusted for population sizes (i.e. membership statistics), for the purpose was to correlate the statistics of the libraries with each other, thus 37 per annum is the simple mean of issues per member for all observations, <u>there was adjustment for year lengths</u>, because one year contained two Easters and correspondingly less open days Thus, the above calculations are not derived from the untreated statistics provided by the London Borough of Havering.

(36a). Even using untreated statistics and single years (i.e. n=10), the rank correlation coefficients are high, $\approx$ 0.9 (Table 8a).

between 0.4066 and 0.5641 for requests per member per annum; and (iii) between 33.02 and 41.83 for books borrowed per member per annum, using three sets of 10 observations, that is a set for each year. Further, for each of the three years, (though n = 10 in each case) all three correlation coefficients were significant. That between (i) issues per member and books on loan at a given time varied between 0.91 and 0.95; (ii) that between issues statistics and requests per member varied between 0.81 and 0.85 and (iii) that between request statistics and books on loan varied between 0.78 and 0.82, for each of the three years.

There was greater variation in some years than others. For example, the regression line expressing 1971/72 request statistics as a regressand of 1970/71 request statistics expressed the equation, $Y = 0.65 + 1.229X$ (Y and X being respectively 1971/72 and 1970/71 requests per member). Against this equation the branch libraries of Elm Park, Gidea Park and Harold Hill appear to have received disproportionately greater numbers of requests in 1971/72. But this difference could be attributed to stochastic factors. The correlation coefficients were sufficiently large to be evidence that, with the exception of the central library, there is significant correlation between the issues of libraries per member and their request (i.e. inter-library loan) statistics per member. The correlation is important, for if we wish to compare library systems we need not worry unduly about central library variation. For every 40 issues in any system we may impute a value of 0.40 for a request, or 1% of all issues. If empirical studies show the value of the inter-library request service to be £1 to the typical member, this may be divided by the annual loans of all books (e.g. 40 per member in this case), and the value of 2½p added to the loan conversion statistic to include the inter-library benefit conversion factor in the total conversion factor for the purpose of estimating the total benefit of a system from its lending library issue statistics. The central library differences can be disregarded for the purpose of conversion because all members that make inter-library requests at central libraries are not central library members. Thus, the inter-library loan benefit is not simply correlated to the issue statistic: it is also proportionate to it.

The matter did not rest with the simple study of the Havering issue and request statistics, but was followed with similar studies using the data from both county boroughs and counties. In the cases of Bristol and Cardiff, for example, the statistics of issues per member were tested for the period from 1969/70 and 1972/73 and, though request statistics were not available for all years, the inter-year correlation was comparable with that of Havering. Individual branch statistics were available from the county library authorities of Flint (now Clwyd), Lincolnshire (Lindsey and Holland) and East Sussex. In the case of Flintshire, the correlation included 23 libraries, ranging from the Central library to 4 mobile libraries and 2 container libraries. The statistics were partly distorted by the very high rate of books on issue at one time per member from one mobile library (11.9), but there was an inter-library variation of between 0.79 and 3.30 books on issue per member, after excepting the mobile library, the books borrowed per member varied between 40 and 52 in frequency and request statistics were more exactly correlated to issue statistics (0.69) because of larger number of libraries. Further, for most years (e.g. requests 27,264 in 1972/3 compared with issues 2,863,460 in 1972/73) the ratio of 1% requests/ issues, coincided with that calculated for the London borough of Havering, despite the dissimilarity between library authorities.

Tests were conducted with the statistics of other county library systems. For example, for the years 1969/70 to 1972/73 the statistics of the Lincolnshire (Lindsey and Holland) library authority indicated that rates of issues per member varied between 30 and 52. Part-time libraries generated a mean issue rate of 36 per member, staff-centred service points a mean issue rate of 41 issues per member and mobile libraries, 44 issues per member. In this case the information about request statistics for some smaller branches was incomplete, but most was available from district librarians' reports. In some cases the ratio of request statistics to loan statistics was lower than that for Havering and the pre-reorganisation county of Flintshire (i.e. 0.6% in the case of some libraries) but this was because of the effect of high issues from mobile libraries rather than because of the possible instability of this ratio. Even if there were variability of between 0.5% and 1% in the estimation of request statistics from loan statistics, it would result in a variation of less than 2p in our conversion factor, and as the total conversion factor varies between 40p and 50p, as will be shown later the variation in the proportionate 'slice' of interlibrary benefit associated with each bookloan is not statistically significant. We may thus conclude, in the absence of further evidence, that the library loan statistic may be used for estimating the benefit from the inter-library loan service even if no request statistics are available, but further evidence is available in (b) and (c) of this chapter.

(b) Questionnaire results: Individual Borrowings and Other Benefits

Attention now turns to the questionnaire which was intended as a follow-up and longitudinal study of the estimates of the modal value of a library loan obtained for the earlier thesis (6). It was not intended to be a longitudinal (or panel) study in the strict statistical sense, for most of the 311 respondents to the first questionnaire were local (i.e. resident in the London area), since the main object of research in the M.Phil (6) thesis was the revenue cost and library issues of the 32 London boroughs. The 607 respondents to the second questionnaire were more widely distributed geographically, and included, for example, a Scottish civil servant and people who resided as far west as Cumbria, Wales and Cornwall. Not all 607 replies could be used for each question, for inbuilt consistency checks (as, for example, in the answers to questions 6, 10 and 11) indicated that some specific answers were not valid. Further, the respondents were directed not to answer questions to which they were unable to give good estimates as answers. Thus the total frequency of answers was not 607 in all cases, and because some foreign students interpreted 'reference library' to mean 'academic reference library' some, but very few, answers to questions 15 and 16 were regarded as invalid. The questionnaires are reproduced in Tables 1 and 2.

The results of tests on the answers to some questions are interesting. Let us consider those which are relevant to the correlation between lending library activity and the activity of other library functions. (Tables 1 to 11).

For all valid answers (n = 231) there is a highly significant correlation between (i) browsing before borrowing and (ii) borrowing (0.41), but there are exceptional cases where people go to a lending library to browse rather than borrow. Only in one case did a respondent claim that he browsed 20 books for every 1 borrowed. As he also claimed to read only 40 books per year, interpreting the first question strictly, there is little doubt that his browsing was very casual. In most cases the browsing/borrowing ratio was 2:1 Thus, it is not simply plausible, but highly probable, that there is a good general correlation.

between the frequency of issues (loans) and the extent of browsing in any library, or library system, and that the issues statistics may therefore be used as a valid estimator of the benefit received from browsing.

The benefit from the reference service could be examined in several ways. In the first place, the frequency of library book consultation can be correlated with the frequency of borrowing, the annual frequency of reference library book consultation being the product of the answer to questions 15 and 16. This approach was rendered somewhat difficult by the large number of blanks in response to questions 15 or 16. However, there was, for $n = 310$ in the case of question 15, and for $n = 257$ in the case of question 16 a significant correlation between (i) numbers of books consulted on each visit and annual frequency of books borrowed from the lending library; and between (ii) frequency of visit to the reference library and frequency of books borrowed from the lending library. The coefficients were 0.35 and 0.62 respectively.

Secondly, because the lack of answers to questions 15 and 16 indicated a probability that some of the actual answers may be inexact estimates, I attempted a direct approach to the question of category correlation between benefit from the reference service and the frequency of borrowing from the lending library. This involved the classification of answer to question 4(c) into the categories '0 and under 20', '20 and under 40', '40 and under 60' etc., and the classification of estimates of annual benefit from the reference service into simple approximations of £1, £2, £3 £4 and £5 respectively. Thus there were 4 categories of answer to question 4(c) and 5 categories of answer to question 21(a), and theoretically 12 (i.e. (4-1) x (5-1)) degrees of freedom. The chi-squared test was difficult to apply to all categories, because of some zero categories, but these were, in themselves, proof of the association between high frequencies of borrowing and high estimated annual benefit from the reference service. It was observable that none of the first category of borrowers 'under 20 books per annum' expressed the value of the reference service as over £3 per annum. In the second category '20 and under 40 books per annum' less than 15 of respondents valued the library reference service at more than £3 per annum, but in the categories of more frequent borrowing '40 and under 60' and 'over 60' values of the reference service were more commonly at £4 and £5 per annum. Where the expected and observed frequencies in all available categories were tested against each other, some differences were not significant at the 5% level, partly because of the asymmetric category distribution of frequencies in both cases, but a 2 x 2 test of association using the categories '60 and over' and £5 per annum did show that there is a positive association at the 5% level of significance between very high annual frequency of borrowing and very high valuation of the reference library service. (36b).

The questionnaire was also used to confirm (or test) some of Luckham's findings about the frequency of visits to libraries for reference purposes, and also to discover whether there was positive correlation between total library visits and reference library visits. Answers to questions 12, 14 and 15 indicated that the ratio between total visits to a public library and specific visits to a reference library varied between 12:1 and 7:1, but that the correlation coefficient was significantly high (0.37, where n = 310). Very few respondents interpreted the word 'specifically' in question 15 to mean 'only', i.e. without visiting other departments of the library. This was evident from the answers to question 14. Conversation and interview with some respondents showed that this was because very few people specifically visit a library for the purpose of

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36b. A chi-squared test of all single categories can only be applied by reducing invalid cell-frequencies (those less than 6) and correspondingly reducing degrees of freedom (i.e. to 9).

reference, this being thought a diseconomy. Most borrowed books at the same time. Further, the relative size of frequency of reference library visit, when obtained by empirical means, added further evidence that, in comparison with reference library activity, lending library activity is sufficiently large to become a good estimator of the activity of the system as a whole. (37)

Thus, we have examined browsing and the frequency of reference library consultation and have seen that there are:

(i) a good case for a correlation between the browsing and borrowing benefits from libraries, because of the significant correlation between readers' estimates of their frequencies;

(ii) a reasonable basis for stating that there is a good correlation between frequencies of lending library and reference library usage, because there is a significant correlation between reference library visits and book borrowing and between reference library consultation and book borrowing;

(iii) good evidence for stating that, particularly at very high category frequencies there is an association between readers' estimates of the annual value of the reference service and their borrowing from lending libraries; and

(iv) a significant positive correlation between total visits to the public library and the usage of the reference service.

Before leaving this particular section of the chapter we may consider the correlation between the inter-library service usage and valuation and the frequency of borrowing (per annum) from the lending library service. Again, the categories of valuation (per annum) were £1, £2, £3, £4 and £5 respectively, and many respondents gave identical values for both reference and inter-library services, but where they differed, lower values were assigned to the

(37). The detailed category evidence is provided in Tables 3 and 4 of the Appendix.

inter-library service. In this case there was a highly significant positive association between the '£5 per annum' category and the 'over 60 books per annum' category, but a 5 x 4 chi-squared test was again impracticable at 12 degrees of freedom, for in this case neither the 'under 20 books per annum' nor the '20 and under 40 books per annum' categories were prepared to value the inter-library service at over £3 per annum. There was thus perfect <u>one-way association</u>, but not <u>two-way</u> association, because some frequent borrowers in the '40 and under 60' and 'over 60' books per annum categories were not prepared to assign high values to their usage of the inter-library service.

Stronger proof of an association between the value of the inter-library service and the frequency of borrowing is not required, for we have already shown in subsection (a) of this chapter that, from secondary data, there is a high positive correlation between the frequency of inter-library borrowing and that of borrowing (except in the case of central libraries). It should be stated that the mean value in response to questions 19 and 20 was 0.4, but that only 35% of readers answered this question.

<u>(c) Observation Data: Occupancy and Borrowing Frequencies.</u>

The third means of obtaining evidence from primary data was by observing and compiling data about the frequency of issues (loans) and comparing this with contemporary occupancy (i.e. frequency of persons) in the lending and reference departments of the relevant library. Spot counts were made at the libraries of Enfield, (Chase and Ponders End), Haringey, Havering, Waltham Forest, Old Cross (Hertford) and Ware, and smaller samples were taken from libraries as distant as the new library at Hayle in Cornwall and two in North Wales.

In some cases the number of library users was counted at the beginning of the half-hour period, by visiting both lending and reference sections, and the issuing process was then observed at some distance. This method was applied to the more distant libraries early in the research period. Some observations were made during the period prior to submission of the M.Phil thesis (6), but the analysis of that data was not then pursued because the objective of that thesis was to evaluate the benefits of lending libraries as lending libraries. The correlation of frequencies of readers in the different departments of libraries at different points of time would not, in itself, be adequate evidence that the issue statistics of lending libraries are a valuable base for estimating total library usage (i.e. including that of reference libraries) were it not for the fact that issue frequencies correlate with contemporary user frequencies of both reference and lending departments in most libraries visited. It is almost obvious, from the questionnaire data already examined, that there is a high positive correlation between reference and lending department usage and the issue statistic, but unless it were proved to be also the case from observation data, the argument in its support would not be complete.

In most libraries it is difficult to obtain information about issues in the short period (e.g. half-an hour) without disturbing the work of library assistants. For the purpose of examining Hertfordshire library issue frequencies this was unnecessary, for a system of photo-charging is employed, where numbered issue tickets are inserted in books every time they are issued. As the numbers of the issue tickets are always serial, it was simply necessary to adopt the following procedure:

(i) borrow the first book of a pair on arriving at the library;

(ii) count the frequencies of users in the reference, lending and other rooms;

(iii) leave the library half-an-hour later and borrow the second book of the pair; and

(iv) subtract the first issue number from the second (for example N2282 - N2218 = 64), and thus obtain the exact number of books issued during the half-hour period without (a) watching the issue process or (b) disturbing the work of library assistants.

Specifically, in the case of the Old Cross library, Hertford there were 269 visits in the period between November 1974 (37a) and November 1977. This particular library consists of : (37a)

(i). a ground-floor fiction lending library, including a children's and reading room section; (ii) a first floor non-fiction lending library; and (iii) a first floor reference library. Although some visits were made on more weekdays than others, and therefore the sampling procedure may be slightly systematic, the total sample of 269 visits was representative. The mean of persons using the small reference room was 3.319, but the frequency of users ranged between 0 and 10, with a standard deviation of 2.28 and a high coefficient of variation. The mean of persons using the upstairs (non-fiction) lending library was 7.66, with a standard deviation of 2.755, and a lower coefficient of variation, but the actual range was larger though the frequencies were more bunched. The mean of downstairs (fiction) library users was 8.59, but users ranged as high as 23. Frequencies of book-issues within half-hour intervals ranged as low as 35 and as high as 110. The mean was 66.8 and the standard deviation 12.18. In all cases the frequency distributions of persons using reference, non-fiction and fiction rooms and of contemporary issue frequencies were positively asymmetric (skewed), the modal number of issues within a half-hour period being 59, not 66.8 as the mean would indicate.

But all activities were highly correlated for the 269 observations. The correlation coefficient between reference library usage and lending library issues was 0.648; that between non-fiction library usage (browsing)

37a. This particular library was re-arranged, the reference library being originally downstairs. Most of the frequency counts were made after the re-arrangement. In all cases user-frequencies were easy to obtain.

and the frequency of issues was 0.862 and that between fiction library usage and the issue statistic was 0.585. Over 75% of the variation of the issue statistic can be explained by joint regression on the two lending library variables, the equation:

$$Y = 32.226 + 5.131X_1 - 0.550X_2$$

expressing the relationship between the variables where Y represents the frequency of issues, X_1 the frequency of occupants of the non-fiction lending library and X_2 the frequency of occupants of the fiction lending library. There was also some association with the enquiry-tally counts at the reference desk when these were available to me. (37b)

This is not to say that the correlation between loan-issues and fiction library usage is too low for consideration. It is highly significant, for where n = 269 a coefficient of 0.3 is significant at the 1% level of significance, and in this particular case the coefficient is nearly 0.6. There are indications, from a small sample of newspaper reading counts, and specific counts of people waiting at the enquiry desk, that the coefficient would have been much higher, if these had been included. The relevant measures in all three cases, are the correlation coefficients, for they show, in this particular library, a very high correlation between (i) reference library usage; (ii) non-fiction library usage and (iii) all other components of total library usage and the rate of issues (loans) from the lending library.

The evidence for Ware in Hertfordshire related to a smaller sample (46) of observations, and to an earlier period (1972 - 1974). In this case many of the issue frequencies were observed, as were the sample of 22 at Enfield Chase and 38 at the Ponders End library, but observations were made over a longer period.

In general I should state that frequent observation of

37b. This was sometimes left open on a desk in the upstairs reference library and could be glanced at without disturbing anyone, or even requesting the information.

the issuing process was avoided for this particular research method would not only have delayed the work of library (37c) assistants but have retarded the process itself and have resulted in incorrect data. My method was thus to conduct this kind of research in libraries where the photocharging (individual issue ticket) method was used, and to take infrequent samples from other libraries.

The conclusion that all library activities are correlated, and that the lending rate (per half-hour) can provide a good estimate of the numbers of people using not only the lending library, but all other library functions during that half-hour may seem too obvious to have to be 'proved', but if a model of total library usage and benefit is to be constructed, using the lending rate as an activity index, such proof is necessary.

In this case, the high correlation coefficients in the Old Cross, Ware, Enfield Chase and Ponders End cases and median tests using 2 x 2 contingency tables categorising high and low frequencies of attendance and loans shows that all forms of library functions are correlated beyond all doubt. The reason for the high correlation is obvious. It is that people are not uneconomic in their visits to libraries, and thus they may not necessarily always tend to visit reference departments when they visit lending libraries to borrow books, (indeed they do so in only about 10% of cases), but in a significantly large number of cases they <u>do</u> borrow books from lending libraries on the same occasions as those primarily intended for consultative use of the adjoining reference libraries. Tables 5,6 and 7 of the Appendix provide summaries of the results of most observation research into this relationship. Table 7 particularly summarises the results for non-photocharging libraries, and these do not differ materially from those from the

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37c. In general, library assistants were not made aware that they were being observed, because of the likelihood of statistical observer interaction, i.e. that the knowledge of observation would affect the issuing process, quite apart from the inconvenience that it would have caused.

libraries where photocharging methods were used. Previous research (6) had, in any case, made it clear that the main factor which would constitute a likely cause of between-groups variance in libraries is social class (38), and as there is no known reason why the proportions of social class differences should be dissimilar in systems which use photocharging as against other systems, the results of the smaller sample of observations from non-photocharging libraries were expectedly no different from those of the larger sample from photocharging libraries.

Thus, from the high positive correlation between lending library issue data it was possible to conclude that lending library issue statistics not only provide direct data concerning the usage of a lending library, but may be used to provide a valid indirect estimator of a population's use of its total library system.

There are, of course, three special cases where the issue statistics do not form an estimator of total library usage, but they may be taken into account when using lending library issues as estimators of the value of the total system. They are:
(i) the statistics of mobile library issues, where there is obviously limited 'browsing' and no concurrent access to a reference library;
(ii) the data of books issues from small branch libraries which have no reference shelves; and
(iii) the book loans of hospitals and institutional libraries.

Such cases do not render our proposed usage of the

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(38). The M.Phil study of the 32 London Boroughs (6) indicated lower borrowing and more fiction borrowing in boroughs with low relative percentages of owner -occupied housing. Further, subsequent studies of branch issue data from Cardiff, Bristol, Luton, Southend-on-Sea and two London boroughs show that branches in areas of known lower social class populations have lower borrowing and relatively greater fiction borrowing, except for Junior issues.

lending library issue statistic impossible, nor do they invalidate the hypothesis that the lending library statistic is a valid estimator of total library activity and benefit, for :

(i) mobile, small branch, and institution lending library issues can be multiplied by a different conversion factor which does not take into account an apportionment of the benefit from reference libraries; and

(ii) there is some evidence for stating that the (38a) value of a bookloan to a reader in any of these three categories is higher than that of a bookloan to readers who borrow from large urban libraries, so that, even if a uniform conversion rate is used for all issue statistics the estimation error is partly compensating.

We are now in a position to summarise the matter, and to conclude, from the evidence which has been provided, that the statistics of issues from lending libraries are the most useful data in existence for estimating the parameters of the total benefit obtained by a population from its library system because:

(i) the corporate non-specialist nature of the public library service (in contrast with that of academic libraries, and in conformity with professional objectives) dictates that the benefit (that is, social income) from the public library service should be considered as a whole, and the lending library service satisfies most of the specific, subsidiary objectives;

(ii) the lending function is, to an extent of 90% usage of resources, 75% popular usage, and for reasons related to public relative valuation and home usage, the largest 'product' of the library service, and component of social income (to pursue the analogy with commercial firms); and

(iii) all evidence from published and unpublished secondary data, from two questionnaire surveys and from several observation studies, show that, in general, all forms of available library usage correlated with the lending function.

38a. Using opportunity cost criteria, where there is deprival of access to larger libraries.

1.4. The parameters of bookloan valuation

Having shown that annual lending library issue statistics can form an estimator base for the estimation of the total annual (social) income of a library system it is now necessary to discuss two methods of 'translation' of issue statistics into 'money equivalents'. Ideally it may be thought necessary to 'translate' statistics of the loan of each separate volume in a collection using the product of its 'issue value' and the frequency of its usage, so that the annual benefit from each volume is $\Sigma f_i x_i$ where x_i is the value of the issue of a particular title and f_i the frequency of issue of that title. Apart from the cumbersomeness of this method even with computers, it produces a false sense of accuracy because:

(i) a bookloan does not have the same value to two (38a) different people (even though it may be the same title) nor to the same person at different points of time;

(ii) even though it may be possible to assign a value to the loan of each particular title, the process of aggregation would remove some of the exactness of loan-value for each title, while the same process of aggregation reduces the statistical error in estimates of the value of a bookloan as a 'modal' statistic;

(iii) the value of the loan of a specific title tends to fall as it becomes more dated, and this decline of value is reflected in less frequent borrowing (39), and if each title-loan is to be differently valued because of varying cost and worth the loan values of each title would have to be periodically reduced because of 'title-depreciation', a concept, which, in itself, places spurious accuracy in such a model; and

(iv) the value of money is, in itself, a variable and thus an accuracy based on the loans of specific titles would be reduced by other factors.

38a. To illustrate this, compare the value (in opportunity cost) of the loan of a specific investment textbook to a casual reader, with its 'loan-value' to a candidate for an imminent finance examination, or before a large investment deal.

Two solutions may now be proposed. The first is that we look for the modal value of a bookloan, irrespective of title, at the 95% and 99% confidence levels. This method proceeds one stage further than the method employed in the previous thesis (6), which, using the accounting concept of conservatism, obtained, for the London boroughs, the minimum realistic value which people would be prepared to pay for the loan of the 'average' book. The previous questionnaire obtained data on a 'single answer' basis and compared this with:

(i) second hand book values;

(ii) proposed royalty payments for the lending library right;

(iii) commercial library subscriptions of earlier periods adjusted for inflation; and

(iv) amounts paid by a public for 'throw-away' reading (e.g. newspapers, and small periodicals).

Research methods now require that this kind of methodology should be extended, so that :

(i) consistency checks test the validity of estimates of the value of a bookloan; and

(ii) the frequency distribution of such estimates is calculated, to discover the 95% and 99% confidence levels of the population distribution for all bookloans.

The 'modal value' approach is not entirely satisfactory for it does not ask whether the value of a bookloan does or does not vary with the value of the book or with the type of book using:

(i) commercial price categories;

(ii) subject classification and

(iii) the type of user or the purpose for which the book is borrowed.

The second solution would at least require this kind of estimate valuation

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(39). This matter has been pursued in the earlier study (6) by Escarpit, Urquhart and Urquhart and by Buckland. All these references will be discussed when dealing with capital expenditure on bookstocks.

It is not necessarily true that the value of a bookloan varies with any or all of these factors. A reader is not necessarily prepared to pay more (in the event of a commercial library service) for the loan of a high commercially priced book than for the loan of an inexpensive one, although the fact that there is variation in readers' valuations of different titles is evident from the differences in demand for different titles. But the question whether this valuation varies with any or all of the factors, (i) commercial price category, (ii) subject classification and (iii) type of user requires full exploration.

Thus, in the remainder of this chapter it is necessary to analyse responses to questions intended to estimate by empirical means:
(i) the 'modal' value of readers' estimates of bookloans of all categories, so that its parameters can be more closely examined, compared with the estimates obtained from previous studies and the probable frequency distribution constructed; and
(ii) the extent to which this value may, perhaps, differ for books of high and low commercial price categories, different subject classifications and for different types of user.

The questionnaire in Table 2 of the Appendix can now be discussed in more detail. Questions 1 and 4a were intended to check that the sample (39a) of readers questionned had a sample mean of reading frequency per annum consistent with that obtained from published data in librarians' and branch librarians' reports. Questions 2 and 3 intended to ensure that all components of the population were represented in the sample.

(39a). See Tables 10 and 11 for frequency distributions

Question 4 categorised the composition of reading material, but 4(c) was regarded as the most important part of this question, because attempts were made to correlate lending library reading with total reading. This not only attempted to evaluate statements made by Stoljarov (40) in the light of United Kingdom reading frequencies, but to assess whether high annual borrowing frequencies for some mobile libraries (over 50 per member in some cases) indicated that these books were actually read, and that annual borrowing frequencies are consequently less than annual reading frequencies.

Question 5 attempted to find whether there was a particularly popular rank order of valuing the library service. If, for example, it could be hypothesised that a significantly large number of respondents were prepared to pay a percentage of the value (cost) of a book for the opportunity of borrowing it, there would be a prima facie case for categorising the issues of books from lending libraries to show how many books costing under £1, £1 and under £2 etc. had been borrowed during a period and for applying a percentage (e.g. 12%) of the median value of each category to the frequencies of issues to obtain the aggregate value of the lending service in a given period. If the bulk of readers were more prepared to think in terms of paying a fixed charge per book borrowed, there is a plausible case for simply multiplying the aggregate issues for a period by a uniform value, i.e. $L_t.\Sigma m_i$ as hypothesized.

Question 6 was a development of a question used in the earlier research questionnaire (6) . One could have 10 category intervals of 10%, but this would have confused many respondents. It was thought better to recognise the improbability that many respondents would regard the value of a bookloan as over 50% of the book's commercial value, and yet recognise the importance of

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(40). Stoljarov, Ju.N. (Moscow State Institute of Culture) Optimum Size of Public Library Stocks (Unesco.Bull.Libr. XXVIII.1. Jan-Feb, 1973) Unesco.

the 10% interval, because of the findings from earlier researches. The requirements (i) that the questionnaire be as simple as possible and (ii) that the 10% and 50% proportion category boundaries appear in the questionnaire were both considered in devising the categories (a) to (d) of question 6.

Questions 7, 8 and 9 were necessary for an attempt to discover whether the modal value of the loan of a book varied for any (or all) of the categories listed.

Questions 10 and 11 were devised primarily as a check on the answers to questions and as a means of ensuring that (40a) the sample of respondents was representative of the population, since published categories of bookstock prices are available for the purpose of comparison with readers' answers. Public Library Statistics, published by the Society of County Treasurers and the Chartered Institute of Public Finance and Accountancy, contains columns giving the category frequencies for each price (cost) of book.

Questions 12, 13, 14, 15 and 16 have already been partly considered. The purpose of these questions was to find, by empirical means, the relationship between frequency of visits to a public library and reference library usage. It is true that Luckham (26) and others had already published some research findings on the relative usage of the lending and reference functions, but the purpose of the questions was not only to test that the relative size of the reference function was small, but that it correlated with lending library usage.

Questions 17, 18, 19, 20 and 21 were intended to compare the size of the other benefits, not necessarily identifiable with the issuing procedure, with the lending function and to test whether they also correlated with the issuing (lending) function.

(40a). To explain more fully, the value-categories of the 'population' bookstocks are obtainable from published sources, while those categories preferred from the sample (respondents) in their borrowing acted as a check of the validity of the sample.

Questions 22 and 23 were intended to obtain some public opinion on the funding of public libraries, to ascertain whether the current pattern of capital and revenue expenditure on libraries accords with popular requirement. The answers to these two questions are not relevant at this stage.

Having examined the questionnaire in some detail we are now in a position to ask the remaining questions detailed in the introduction. They may be categorised thus:

(i) whether readers consider that a bookloan can have a general, average or modal value;

(ii) whether this value is consistent with individual opportunity assessments of annual values of lending services when compared with their individual annual book-borrowing frequencies;

(iii) the extent to which the value of a bookloan must be increased to account for other aspects of library benefit, for example that from the reference, inter-library and other services and from 'browsing'; and

(iv) whether the modal value of a bookloan is sensitive to cost-differences or category differences of books.

Before asking these questions it is necessary to ensure that the sample of questionnaire respondents was a valid sample of the population of library users. One method of doing so was by conducting a validity check on the frequencies of books read per annum and on the ages and occupations of respondents.

From the standpoint of annual usage it was discovered that the frequency distributions(41) (i) of books borrowed from libraries and (ii) of books read per annum were both positively asymmetric, and thus that there was a danger that the correlation coefficient between these two variables (0.782) was affected by

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(41) See Tables 10 and 11 for these frequency distributions

a relatively small number of very high values of both variables. If Y is used to represent the number of books which are borrowed from public libraries by individual readers and X represents the total number of books read by individual readers, the relationship between the two variables can be expressed by the regression equation:

$$Y = 8.971 + 0.574X$$

The mean value of total books read per annum was 42.1 and the mean value of books borrowed from libraries was 32.9 and in both cases the standard deviations of values were high, 31 in the case of question 1 'all books read per annum' and 22 in the case of question 4(a) 'books borrowed from public libraries', so that the coefficients of variation in these cases vary between 0.67 and 0.75.

The size of these coefficients of variation is not merely an indicator of the wideness of dispersion, but also of the extent of asymmetry (skewness) in the frequency distributions of both variables. Despite the asymmetry, and the consequent lack of confidence in the correlation coefficient as such, it could, nonetheless, be stated with a high degree of confidence that there was seen to be a very high correlation between total reading and library borrowing, for the rank correlation coefficient (0.521) calculated for all readers was lower but still significant, having been affected by rank differences at or near the mode of the frequency distribution.

Both coefficients were, however, affected by:
(i) a few cases of high frequency readers whose public library borrowing frequencies were low because they used academic libraries;
(ii) respondents who relied on their own reading resources; and
(iii) the likelihood that some respondents borrowed books from libraries, but did not read them, or categorise them for questionnaire purposes, as having been read entirely.

Table 10 in the Appendix provides the relative frequency distribution of books read per year, and Table 11 provides the relative frequency distribution of books borrowed from public libraries. It can be seen that although the means in the two respective distributions are 42.1 and 32.9 the modes are much lower for the means have been affected by the extremely high values in the two distributions. Thus, for example, some readers read 200 books per annum, but these were few. The distribution has thus a very small upward-tailing curve.

Three reasons have been given for some lack of correlation between total books read per annum and books borrowed from public libraries, and it is best to explain evidence in support of (i) and (ii). In one case, an estimate of Y = 57.7 was projected from total reading frequency per annum X. Actual borrowing (Y) was only 9 books per annum, a regression error of 48.7. Despite the normal anonymity of questionnaire responses, the respondent was identified as a Scottish civil servant who possessed a very large library and also used a special library, but was unable to visit a public library frequently because of its lunchtime distance from his office. The regression equation was usually reliable, however, for in most cases the regression error (that between observations and estimated annual frequencies of borrowing from libraries) did not exceed 10 books per year.

It should be stated that the evidence for (iii) above came from a small number (4) questionnaires where the number of books actually borrowed from a library were more than those (library and non-library) read per annum. It was concluded that in these cases not all borrowed books were read.

Having obtained these sample statistics about annual reading and annual borrowing it was necessary to ask whether these were representative of the 'population' of library users generally. From secondary data for a large number of libraries, including three county library systems, five county boroughs and several London boroughs (42), it was seen that the mean number of issues per member, using total branch issue statistics divided by number of members (or similar formulae) actually varied in an effective range between 22 and 45 issues per member, but with a mode between 30 and 35 issues per year per member. The major exception to the effective range (42a) is the mobile library category where issues per ticket can be as high as 60 in the case of newly opened mobile libraries. Thus, the sample can be considered valid, not only from the standpoint of sample size, but because the frequency distribution of books borrowed from libraries by respondents falls within the parameters of the population frequency distribution of books borrowed per year per member.

Questions 2 and 3 were also intended as tests of the validity of the sample. Question 2 was intended to check that the sample did not consist of too many students and professional people studying for qualifications. But because of the purpose of the study, that of valuing benefit, some disproportionate stratified sampling was necessary, particularly in respect of children, who were not approached for information below the age of 12, and infrequently approached below 16. The question of junior loans poses the obvious problem that children's scales of financial values

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(42). The counties of Clwyd, Lincolnshire (Lindsey and Holland), the old county boroughs of Bristol, Cardiff and Southend-on-Sea, the London boroughs of Camden and Havering and other detailed statistics from other authorities relating to books borrowed per member, e.g. Oxfordshire.

(42a). Using the statistical definition of the term 'effective range' given by Kendall (see 43), i.e. the range, after eliminating exceptional cases (i.e. in this case issues from mobiles per annum per member).

are different from those of adults. This limitation of analysis was not as great as one might think. Discussion with adults about the sums which they would be prepared to pay for the 'average loan' of a book on behalf of their children indicated that it was not significantly lower than that for the average adult bookloan.

Having examined the questions relating to the validity of the sample and concluded that, not only from the standpoint of sample size but from that of the relevant population categories of library readers, the sample was valid, we are now in a position to ask the first of the questions listed on page 50, that is, whether the users of public libraries consider that a bookloan can have a 'general', average or modal value, despite the dispersion in the types, categories and values of the books concerned.

There is evidence, from answers to question 5, that they can, and do, think of each successive bookloan as having a typical value, rather than one which varies with the type of book borrowed. Though the application of Friedman's two-way ranked analysis of variance (43) indicated that there was not a significant difference between the rank orders at the 5% significance level, there was a general preference (as 1 in choices of preference) to paying a fixed charge per book borrowed (31%) or a flat subscription per year (30%). A time value of each loan was next popular as first choice (24%) and a loan based on the percentage of book value was relatively unpopular as first choice (15%) but a good

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(43). Kendall, M.G. et al. A Dictionary of Statistics (International Statistical Institute: Longmans) provides details of this test.

second choice (27% of readers).

Thus, although there was no consistent ranking of responses to the four questions, there was evidence to suggest that the largest number of readers would be prepared to pay for the library service on the basis of quantity-usage of books, and were therefore capable of thinking of the benefit of the library service (in bookloans) as the frequency of books borrowed multiplied by a constant (or 'modal' value). Incidentally there was a significantly high level of statistical association between age and the desire to pay a proportion of each book's value for the benefit of a loan (i.e. 15.2 as the chi-squared statistic at 6 degrees of freedom), and a positive correlation (hence negative association) between the frequency of borrowing and the rank (i.e. downward) of the desire to pay a proportion of the book's value in payment for a loan, the coefficient being 0.478.

Thus, we can conclude that this option, that is, the option of regarding each loan as a value variable dependent on the value of the book loaned was generally less popular as that of regarding the loan of a book as having a constant (or less-dispersed) value, and that it was more predominant among mature people and among infrequent borrowers, for as the annual frequency of borrowing increases, so the rank (downward) of this particular option increases. As this option is least popular among most frequent borrowers, and as the largest numbers of issues from libraries are borrowed by 'most frequent' borrowers, there is an even greater case for applying a uniform rate of conversion to issue statistics to estimate the benefit which accrues from borrowing books, than might initially be apparent from the rank statistics provided on page 54.

Thus we can conclude that it is more reasonable to estimate the benefit from a lending library by applying a constant to the number of issues (loans) from the lending library because:

(i) it is the most popular option, in methods of estimating benefit;,and

(ii) the alternative method associated with quantities of books loaned is positively rank correlated with frequency of borrowing and therefore preferred by infrequent borrowers.

The attention must now turn to the second question asked of the data on page 50, that is, whether the value which readers impute to the loan of a book is consistent with individual opportunity assessments of annual values of lending services when compared with their individual annual book-borrowing frequencies.

The solution to this question can best be obtained by constructing two frequency distributions of readers' valuations of the 'average' bookloan, one which uses questions 6 and 11, and the other which directly uses question 10, and then comparing these frequency distributions with each other to assess whether they are consistent with each other.

In fact, the differences in the phrasing of the questions lead to a minor cause of discrepancy. It was intentional that both types of phrasing should occur in the questionnaire so that the discrepancy was, in some measure, unavoidable.

Question 6 asks for the valuation, in terms of how much the respondent would be prepared to

pay (i.e. as a proportion of the value of a book) whereas question 10 asks more directly how much the bookloan is worth to the respondent. It is accepted, at a basic level of economic theory, that people are never prepared to pay under normal circumstances what a good is worth to them, but invariably less than the worth of the good, otherwise purchase or exchange does not take place. Thus, in the case of comparison between these two sets of answers, a few answers emerged where the respondents stated in effect that they would only be prepared to pay 10% of the value of a book for the opportunity of borrowing and reading it, but that the average bookloan was worth over £1. 50p. to them. It does not necessarily follow that the mean price of the books which such respondents were in the habit of borrowing was more than £15. 00 (i.e. $\frac{100}{10}$ x £1. 50p).
In these cases it was evident from answers to questions 7 and 8, that the readers concerned were prepared to pay very much less for the opportunity to borrow (on average) a book and read it than their estimates of the actual worth of the bookloan to them.

Table 9a shows the assessments of the value of a bookloan which readers were prepared to give in terms of the purchase prices or commercial values of the books concerned. Because of the phrasing of the question it serves as an estimator of the lower estimate of the value of a bookloan, (43a) for if the mode of answers to this question is multiplied by the modal value of all books borrowed it will provide us with an estimate of the benefit from borrowing the 'average' book.

Table 9b reconstructs a frequency distribution of readers' estimates of the average value of a bookloan, using the data from Table 9a and adjusting with the answers to Question 10 except where these were significantly inconsistent with the answers to Questions 6 and 11.

(43a). To explain more fully, Table 9a gives frequencies of the 'loan-value' percentages of books' commercial values, the lower estimates of bookloan values are in the notes to Table 9a, while Table 9b effects a reconciliation.

It can be appreciated from an examination of Table 9b that, although the mode is in the category 0 and under 10% of the value of the 'average book', and thus under 10% of £4 (i.e 40p.) taking the average value of a book as £4, the mean is actually estimated from the midpoints of the interval values (55% x 0.05 + 33% x 0.15 + 10% x 0.25 + 2% x 0.35) and therefore approaches 0.11. If applied to a mean value of £4, the mean becomes 44p in terms of estimated 'average' value of each bookloan.

The mode of the distribution is lower, and the interval frequencies best fit an asymmetric distribution where the point-estimated mode is 36p. This is the lowest point-estimate of the mode, and attempts to estimate the modal value of a bookloan merely from answers to question 10 would indicate that the actual value of the average bookloan to the average reader is nearer (43b) 55p., again using the midpoints of the frequency intervals and multiplying by the frequencies of each class. The upper confidence limits of the frequency distribution are much higher, at 95p.

There is not evidence to show that the frequency distribution is a binomial one, nor that it is of the Gini (concentration) kind. The case against a Lorenz distribution (measurable by the Gini coefficient) is based on answers to question 10 which indicate a much nearer approach to a negative binomial distribution.

The responses to question 10 when checked with those to questions 6 and 11 indicated that there is a reasonable case for postulating a higher 'conversion rate' for expressing the benefits of the lending function from the aggregate number of issues, than that estimated in the earlier thesis (6). This was partly on account

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(43b). Of course, (see Table 9a) the mean is actually higher [(0.375 x 325) + (1.125 x 110) + (1.875 x 43)]/478 = 0.6825 = 68p., but this uses estimated midpoints and does not take account of the large number 'under 75p', thus 55p is a more realistic 'average'.

of inflation between the two midpoints of the two periods of research, but partly because the inbuilt consistency check in the questionnaire enabled the parameters of a bookloan value to be more accurately estimated, and the estimate (then 25p) used in that thesis was a 'minimum average estimate' at the 95% confidence level, rather than an estimate of the mode. We can, because of this survey and because of the parameters already estimated in the earlier survey and the other means of estimating the average value of the loan of a book detailed on page 46, state with some confidence, that a conversion rate of 36p can be used to convert the statistics of the issues of books from public libraries into realistic estimates of the 'average' benefit obtained by a public from its lending library service and thus to convert aggregate statistics into aggregate estimates of benefit applicable to the lending service, qua lending service.

It is with the problem of other associated benefits in mind that we can now move to the third question posed on page 50. It is how we can discover the extent to which the value of a bookloan must be increased (as a conversion factor) in order to account for other aspects of library benefit, that is, for example, the benefit obtainable from browsing, from the reference library service with associated information provision and from the interlibrary service. We have already examined evidence that all these 'book' services provided by a public library(in addition to that of actually lending books)have benefits which correlate with the issue statistic. The previous section has shown, from observation, interview, questionnaire and secondary data, that the relative size of these functions is small compared with that of lending books, and that when measured as variables they correlate with the loans of books from libraries.

Browsing presents a problem, and it is doubtful whether (43c) an inflation of the conversion factor is necessary to take into account the benefits which a public receives from browsing in a lending library before actually making choice of a book. No reputable bookshop charges its customers a reading fee for the occasional examination of books before purchasing them and if the question was that of valuing the opportunity to browse before making choice of books to be loaned the added benefit would not be great, a few pence at the most. It has already been stated that there is a 2:1 ratio between books browsed and books borrowed, somewhat consistent with that of, or even less than that of, browsing in bookshops, and also consistent with the large number of replies to questions 13 and 14 indicating that an average period of 25 minutes was spent on visits to a library.

But there is a second category of reader who spends a much longer period in the library generally. Some estimates in respect of this smaller category of reader postulate between 30 and 90 minutes. Here it is evident that the lending library is being partly used as a reference library and any browsing of this kind may be regarded in the same category as the valuation of the reference function. Indeed, the term browsing is less applicable, for this category of reader is systematically using the library as a quiet place to read the books which he may otherwise read at home or elsewhere. Thus, we must ask of the data obtained in response to question 21 whether the annual valuation of the reference function can account for such usage. The hypothesis that some readers (a distinct category) regard the library as a quiet place to read books which others would borrow and read elsewhere is also partly indicated by the high correlation coefficient (0.533) between length of visit to a library and the frequency of visit. For all browsers who did not fall into this

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(43c). To avoid confusion the word 'inflation' in this particular context means the addition of a very small increment to the conversion factor (i.e. m_2 to m_1) to account for the very small benefit from 'browsing' books a and b before selecting book c for loan.

category browsing time was a near-constant (as an average value), i.e. it did not vary much from person to person though it varied from one visit to another If we treat the smaller category of browsers as a type of extended reference library user, then we can use the estimates of the annual value of the reference library service to estimate the extent to which the conversion factor must be increased to account for both 'reference browsing in the lending library' and 'reference library usage'. It should be appreciated that this type of user is a relatively small category and that underestimation of this particular benefit by subsuming it into reference library usage is unlikely to affect the total benefit to any great extent.

Let us then turn to reference library usage. Library users were prepared to pay an annual subscription of an amount which varied from 50p to £5 for this service. The mean of the frequency distribution of estimates (43d) was £1. 62p but its standard deviation was 84, the high coefficient of variation (0.51) reflecting not only the variability of the statistic (affected by different attitudes to library usage) but also the positively asymmetric nature of the frequency distribution. It follows that as reference usage is highly correlated with lending library usage, since the mean annual value of the reference service to its readers is £1. 62p and the number of books loaned from the lending library has a mean of 32.9 per annum, as indicated on page 51, we may add an apportionment of the ratio estimate of $\frac{£1.62}{32.90}$, approximately 5p per loan to account for the benefit from associated reference library usage in the conversion factor. At most, the conversion factor needs to be increased by 2p for the benefit of browsing and by 5p for the benefit of reference library usage from the mode of 36p for the direct benefit from lending to a revised conversion factor of 43p to account for lending, browsing and reference library benefits.

(43d). Including some zero-categories, this mean is lower than that using integer-points of Table 8.

I now turn to the problem of valuing the inter-library loan service and ask whether it is justifiable to increase the conversion factor in order to account for the average relative size of benefit which the 'typical' reader obtains from the inter-library loan service in terms of the average benefit which the typical reader obtains from the loan of a book, thus augmenting $m_1 \ldots m_3$ with m_4 (inter-library benefit).

If there is a good correlation between bookloan statistics and inter-library loan statistics there is reasonable justification for the policy of incorporating a 'slice' of inter-library benefit in the conversion factor for 'translating' issue statistics into estimates of total annual social benefit. It has already been shown when considering the secondary data available from Havering, Lincolnshire (Lindsey and Holland) and Clwyd, that there is very good inter-branch correlation between issue statistics and request statistics. The only apparent exception is the disproportionate inter-library request statistics of central libraries, but this is partly accounted by the fact that some branch ticket-holders actually go to central libraries to find books, and finding them not available request them from central rather than branch libraries, (44). It has already been shown that there is a narrowly-dispersed ratio (ranging between 0.6% and 1%) between the statistics of inter-library loans and the total statistics of a given public library system.

How must we then proceed to account for inter-library

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(44) See page 30 for a detailed consideration of this argument.

service benefit? It is plausible to argue that, since all request statistics are included in issue statistics by virtue of the fact that books are issued after being requested, we need not increase the conversion factor at all. All requests which are are satisfied are loans, and all requests which are unsatisfied do not 'benefit' the reader making the request.

The evidence obtainable from the questionnaire needs to be considered at this stage. Answers to questions 19 and 20 showed that less than 5% of readers used the inter-library loan service more than once per year. The answers were consistent with the ratios which were previously calculated from secondary data, for the average annual request was 0.4, and as the average rate of borrowing per annum was 32.9, the sample statistic was a little more than 1% but was not significantly different in view of the standard error of the sample mean in this case, and the fact that standard deviation was calculated from discrete (i.e. non-fraction) answers.

The answer to question 21b indicates that the bulk of readers place far greater valuation on the inter-library request service than would appear to be commensurate with actual usage. The estimates of the annual amounts which readers would be prepared to pay for the inter-library request service ranged from 50p to £5, as in the case of estimates of the amounts which readers would be prepared to pay for the reference service. Here the mean was lower (£1. 43p) and the standard deviation was higher (91) and thus the coefficient of variation (0.64), but this coefficient again reflected the asymmetric nature of estimates rather than their dispersion. This variable is an interesting one, for it reflects the relatively large amounts which readers would be prepared to pay for a relatively infrequently used service. The statement may be puzzling, but it must be taken in the context of opportunity rather than usage. It is not a necessary inference that since the average reader values the inter-library request service at £1. 43, but only requests 0.3 books per annum, the value of a requested bookloan is 'on average' £1.43/0.3 , or £4. 76. Although the value of a requested bookloan is likely to be higher to a reader than the value of the 'typical' bookloan, the mean estimate must relate to the value of the service, and the opportunity to use it at any time, rather than to the benefit from actual usage.

We have already discussed the correlation between the interlibrary request service and the lending library function using both primary and secondary data but an evaluation of questionnaire answers produced other relevant evidence in this connection. For example, the correlation between frequency of library usage (in terms of answers to question 12) and the valuation of the inter-library request service was 0.544, and the correlation between length of visit and inter-library request service valuation was 0.260. There were similar correlation coefficients between frequency of usage and reference service valuation (0.452) and between length of visit and reference service valuation (0.357).

All these correlation coefficients are significant, for even after invalid answers had been excluded from assessment, the 5% and 1% significance levels of the correlation coefficient are 0.18 and 0.14 respectively, but there is no suggestion of dependence of one variable (44a) on another. Using the same criteria, frequency of visit and length of visit were also significantly positively correlated (0.293).

(44a). In this context I use the term 'dependence' in an inferred 'causal' sense, rather than in the more extensive statistical sense.

The correlation coefficient between readers' estimates of the average value of a loan and their estimates of the annual value of the inter-library request service was 0.32 for a cross-section of the total sample of questionnaires, where answers to questions 6 and 11 were known to be totally consistent with answers to question 10. In this particular case the sample size was 151 and the correlation coefficient was therefore significant at the 1% level of significance.

We can therefore conclude that, because of the high joint correlation between valuation of the inter-library request service, the frequency of books borrowed, the frequency of attendance at libraries and the frequency of length of visit, that there is a good case for adding a small value to the conversion factor to take readers' estimates of the average benefit from the inter-library service into account. As the frequency of books borrowed per annum has a mean of 32.9 and as the mean value of the inter-library service to readers is £1. 43 per annum, it follows that, in view of the high correlation between the two activities, a further 4p (that is, $\frac{£1.\ 43}{32.9}$) can be added to the conversion statistic to account for this benefit. Thus our calculation of the conversion factor becomes:

	p		Notation
The lowest mean estimate of the 'average' value of a loan to a typical reader	36	=	m_1
			+
An estimate of the value of 'prior' browsing expressed proportionately to each book borrowed..........	2	=	m_2
			+
An estimate of reference benefit expressed proportionately to correlated lending benefits	4	=	m_3
			+
An estimate of the inter-library request service, expressing the value of opportunity of using the service in terms of apportionment to each loan	4	=	m_4
Total conversion statistic for all 'book' benefits from libraries	46p	=	Σm_i

This conversion factor is relevant to central libraries and to large branch libraries which provide all services. It is evident from the four category components of the conversion factor that it cannot necessarily be used for mobile libraries, and for small branch and institutional libraries, for they provide no reference service, yet it must be considered that as the component in respect of reference library benefit included a value of benefit to regular browsers at lending libraries, there need not be too significant a difference between the conversion factor for large libraries and for small and mobile libraries. For the purpose of this thesis we shall make a small difference in the conversion factor for small and mobile libraries and assess the extent to which total annual benefits of library systems are sensitive to small differences.

We are now in a position to ask the final question of the data, of those which were listed on page 50, that is, whether the modal value of a bookloan is sensitive to cost and category differences.

The first answer to the question whether readers regard the loan of an expensive book as being worth significantly more than the loan of an inexpensive book must emerge from direct analysis of answers to questions 10 and 11. Taking simply the association between categories containing the highest proportions of books in question 11 and categories of value of average bookloan in question 10 at 8 degrees of freedom (5-1) x (3 - 1) the chi-squared statistic was only 10.1 and not significant at any critical significance level. Further, the selection of the most-favoured category as the only category under responses to question 11, introduced an inbuilt polarization into the test, which would not have been the case if all proportions of all categories had been considered. Thus the calculated chi-squared test statistic represented the maximum possible level of this coefficient. A lower level of the statistic would have been lower. There is thus no significant association between the value categories of books borrowed and the typical values of loans to readers.

The second set of evidence which must be considered may be obtained both from questionnaire responses and from date label analysis. In the first place, the aggregation of the proportions of the books borrowed under individual value categories, from question 11, indicated the relative frequencies 28% and 24% respectively under categories a and b. and only 23%, 18% and 7% respectively as answers to question categories c, d and e. We must allow for some respondent inaccuracy in the data, for most readers do not ascertain the price of each book before borrowing it. However, it is evident from the data, that the aggregate relative frequencies of the five value categories do not differ significantly from the value categories of the library bookstocks themselves. (44b).

A second source of approach to this question was the analysis of date-labels on random selections of expensive and inexpensive books. Again, the borrowing frequencies of expensive books did not differ significantly from inexpensive ones, yet there would be a significant difference if the typical reader considered that he was having better value by borrowing expensive books than by borrowing inexpensive ones,

(44b). Karunaratne actually assesses the value of a bookloan as x% of its commercial value, but his findings are not necessarily invalid. In Australia, where subscription libraries survived until recently (e.g. Queensland), there may be more 'value-consciousness' in borrowing (see 1 supra).

All the tests which were carried out, using methods allied to date-label analysis, to ascertain whether there was a significant correlation between book-prices and book-usage, or an association between value-categories and book-usage, were negative in result. Every case had a similar result, and samples were taken from twelve public libraries (again, as distant from each other as Llangollen in Wales and Hayle in Cornwall). In all cases:

(i) the correlation coefficient between cost and usage, taking samples from books of different classifications, was not significant; and

(ii) the mean frequency of book borrowing per book did not differ significantly between expensive and inexpensive books.

In this case we may infer that, if readers were so price-conscious in their selections of books to be loaned, that they valued the loan of each book in terms of its commercial price, there would be a greater demand for the loan of expensive books than for the loan of inexpensive ones. The answers to question 5 must again be considered in this context. From both categories of data the most logical inference which we may make is that most readers do not use libraries to get 'value for money' (in the commercial sense), but to read whatever books they may be disposed to read at any given time either by study, necessity or even impulse.

Thus, while readers generally regard the value of library usage as a function of the frequency of borrowing, not many, except the most price-conscious, regard the value of library usage as a function of book prices. The loan-popularity of some books is obviously much greater than others, just as the loan-popularity of similarly priced film performances may, for example, differ. But such popularity is not a function of cost or of book-price.

Neither is it a function of either general category or of the subject category of a book. The categorised answers to question 8 were few. Only in 38% of cases did readers indicate that there was greater value to them of books in any one subject category, in the sense that the opportunity cost of books borrowed was greater than that of books generally. Further, these category choices were no different from those which would be obtained by random methods. There was no population consensus that books of any general category or subject category had a greater loan value because they belonged to that category.

Secondary data must be considered at this point. An analysis of the subject-categorised secondary data in respect of issues of books at Bristol, Cardiff, (45) Luton and two London boroughs indicates that the relative demand for fiction books is greater in areas of poor or low social class than in those of high social class.

A comparison of the ratios of fiction books to total books borrowed between Bristol (Redland), Cardiff (Splott) and those for Bristol and Cardiff generally, indicate that there is a significant difference in demand. But this is not evidence that people who live in areas of highly significant demand for fiction books, for example, would be prepared to pay more for fiction book borrowing if there was a frequency-based system of paying for library usage. It is instead probable that there would be a reduction of borrowing because of the nature of the districts involved and the comparative poverty of readers.

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45. For some examples over the period 1970-1973, the ratios of Fiction/Non-fiction were 0.82 for Cardiff Central library, 3.4 for middle-class areas such as Whitchurch but consistently between 9.5 and 11.8 for industrial areas such as Splott and over 13.2 for the Cardiff Dock area. Similar ratios were calculated from data sent by the other library authorities mentioned.

Thus, there is little doubt that the loan-value of a book is a variable (for some books are more in demand than others) but there is a good case for concluding that the variable nature of the value of the loan of a book is related to its specific information content (whether fiction or non-fiction) in terms of public demand, rather than to the class of information which it contains or its value as a book. Most respondents, when questioned, were capable of ranking books which they had read in some sort of preference order, and thus from ordinal variability we may logically conclude that different prices could be assigned to different bookloans, if readers were asked to provide values of specific loans at specific times.

But this is as far as one may move with the analysis of variability of book-loan values. All empirical and secondary evidence indicates that book-loan values are neither price-sensitive nor category-sensitive, but are related (in variability) to the impact which the reading of the book makes on the reader, either in respect of information or enjoyment at the time when it is read. (45a)

It is, of course, true that libraries lose larger numbers of high-priced books than of low-priced books either because of theft or of default in borrowing, but this is because the possession-value of high-priced books is greater than that of low-priced books, even where the possession of the book is illegal. But this problem is different from that of valuing a loan, as a loan. The evidence shows that each book-loan has a value, that the dispersion of values is positively skewed, having a mode at about 36p., a lower extreme of zero

(45a). Or, of course, the necessity of reading it for educational purposes.

and an upper extreme of £2 with very few exceptions, that the dispersion of values is generally much smaller than that of the prices of the books themselves and that the dispersion of values is a function of the individual impact of the book on each reader that borrows it, rather than being the function of the book's indigenous characteristics, such as price or reader-class or subject-category.

Thus, while it may have seemed that greater accuracy of a lending service could be obtainable by making a matrix classification of books based on (i) price and (ii) category differences, and applying different conversion rates to the issues of books in each of the price-category cells of such a matrix, it is unlikely that such a procedure would provide a more accurate total value of a lending service than that which would result from using a uniform conversion rate.

Finally, we may, of course, use the only accurate value-indicator that may be available in these circumstances, the borrowing frequency of the book itself, and subjectively price the loan of the book higher if, for example, where the Browne system is still used, it has a larger number of date-label stampings than others. But even this procedure is self-defeating, for the very existence of a larger number of issues in respect of such a book renders it more valuable to the library system as a whole than that of an infrequently-used book, using the usage -value criteria that I shall develop in chapter 9, even if a uniform conversion statistic is applied. We may thus state, with confidence, that loans can be treated as homogenous units for the purpose of estimating the value of a library system's lending function, and for the purpose of estimating the annual value of a library system to its public generally.

1.5. Summary

This is provided in Chapter 10, 10.2. Conclusions 1 to 14.

Table 1. A Reproduction of a Pilot Questionnaire used to obtain datafrom London respondents for the M.Phil thesis on London libraries, and as a framework to the larger questionnaire used in the current study (see Table 2)

A RESEARCH QUESTIONNAIRE TO OBTAIN INDIVIDUAL EVALUATION OF LIBRARY LOANS

Please answer as many questions as you can

1. Approximately how many books of all categories do you read per year? ( )

2. How many of these books are:
   (a) purchased? ( )
   (b) borrowed from a public library? ( )
   (c) borrowed from other sources? ( )
   (d) read in library reading rooms, reference libraries and in shops? ( )

3. Assume that lending facilities were not obtainable freely, and that you had to pay for borrowing books. How would you prefer to pay?
   (a) a flat subscription per year? ( )
   (b) a charge of x% on the value of each book ( )
   (c) a fixed charge per book borrowed ( )
   (d) a charge per book, varying with the length of time the book was borrowed ( )

4. What value, on average, do you attach to the opportunity of borrowing and reading a book?
   (a) under 10% of the value of the book ( )
   (b) between 10% and under 30% of its value ( )
   (c) between 30% and under 50% of its value ( )
   (d) over 50% of its value ( )

5. What proportion of the books you read are read for
   (a) professional and occupational reasons? ( )
   (b) information and education? ( )
   (c) leisure and enjoyment? ( )

Thank you for your co-operation

Summaries of the results of this pilot questionnaire appeared in pp. 206-7 of the M.Phil thesis. The main data differences are discussed in chapter 1 of the text.

Table 1a.

Notes on the answers from this questionnaire.

Some valid results from this questionnaire, first administered to 251 respondents, but with a later control (60) group, the earlier respondents being mainly library members or students are as follow:

Question 1 12,956 (mean = 51) with answers actually varying widely from 1 to 200 per annum. The mean is atypical and results from the inclusion of a few large values. The mode lay between 35 and 40 per annum for the earlier study. The control group mean was lower.

Question 2. Category	Earlier Group		Control Group	
	Frequency	%	Frequency	%
(a)	2074	16	564	23
(b)	9157	71	1512	62
(c)	1685	13	339	14
(d)	0	0	36	1
	12956	100	2431	100
Question 3.				
(a)	169	67	34	57
(b)	0	0	2	3
(c)	27	11	7	12
(d)	55	22	17	28
	251	100	60	100
Question 4.				
(a)	13	5	7	12
(b)	75	30	15	25
(c)	89	35	20	33
(d)	74	30	18	30
	251	100	60	100
Question 5.	Aggregate Relative Frequencies			
(a)	27%		20%	
(b)	18%		19%	
(c)	52%		61%	

Table 2. A Reproduction of the Questionnaire administered to obtain the data used in Chapter One of this thesis

PUBLIC LIBRARY EVALUATION PROJECT: RESEARCH QUESTIONNAIRE

You have been randomly selected to participate in a research project intended to improve methods of evaluating the services from public libraries. All the answers that you give will be treated as confidential. If you are unable to answer any question please leave the answer space blank. Otherwise please tick where appropriate.

1. Approximately how many books do you read per year? (   )
2. Are you (a) under 18? (   );
   (b) over 18 and under 30? (   );
   (c) over 30, and not retired? (   );
   (d) retired? (   ).
3. Would you regard your main occupation as:
   (a) professional? (   ); (d) student? (   );
   (b) clerical? (   ); (e) housewife? (   );
   (c) manual? (   ); (f) other? (   ).
4. How many of the books that you read per year are:
   (a) bought by you? (   );
   (b) given to you? (   );
   (c) borrowed from a public library? (   );
   (d) borrowed from other sources, e.g. college libraries? (   );
   (e) read in reference libraries? (   ).
5. If you had to pay directly for the services of a public lending library (i.e. if there were no free lending facilities), how would you prefer to pay for the loan of books? (Please rank your preferences 1, 2, 3, 4).
   (a) a flat subscription per year? (   );
   (b) a charge of x% of the value of each book borrowed? (   );
   (c) a fixed charge per book borrowed? (   );
   (d) a charge per book, varying with the length of time the book was in your possession? (   ).
6. If you had to pay a charge based on a percentage of the value of each book borrowed from a public library how much would you be prepared to pay for the opportunity of borrowing and reading the average book?
   (a) between 0% and under 10% of its value? (   );
   (b) between 10% and under 30% of its value? (   );
   (c) between 30% and under 50% of its value? (   );
   (d) 50% of its value, or over? (   ).

   Assume 'value' to mean 'shop-price' for the sake of simplicity of answer.

........./continued

Table 2 continued

7. Would you answer to question 6 be significantly different for:

   (a) adult fiction books? ( );
   (b) childrens books? ( );
   (c) adult non-fiction books? ( ).

8. Categorise the subjects where you think that the loan of an average book may be at least 30% of its value (i.e. purchase price) to you:

General	( );	Technical	( );
Philosophy	( );	Arts	( );
Religion	( );	Literature	( );
Sociology	( );	History/Geography	( );
Natural Sciences	( );	Biography	( ).

9. Estimate what percentage of the books you borrow are:

Adult Fiction	( );	Natural Sciences	( );
Childrens	( );	Technical	( );
General	( );	Arts	( );
Philosophy	( );	Literature	( );
Religion	( );	History/Geography	( );
Sociology	( );	Biography	( ).

10. Is the average book-loan from a public library worth to you:

    (a) under 75p? ( );
    (b) between 75p and £1. 50p? ( );
    (c) over £1. 50p? ( ).

11. Estimate the proportion of books that you borrow from a public library, which are valued (e.g. shop-priced):

    (a) under £2. 50p? ( );
    (b) £2. 50p and under £5. 00p? ( );
    (c) £5. 00p and under £7. 50p? ( );
    (d) £7. 50p and under £10. 00p? ( );
    (e) £10. 00p or over? ( ).

12. How many times per month do you visit a public library? ( ).

13. How long, on average, does your visit last? ( ).

14. What proportion of this time do you normally spend:

    (a) in the lending library? ( );
    (b) in the reading room? ( );
    (c) in the reference library? ( ).

15. How many times a year do you specifically visit a reference library? ( ).

........./continued

Table 2 concluded

16. How many books (approximately) are you likely to consult when visiting a reference library? (   ).

17. How many books do you 'browse' through on each visit to a lending library before making your selection of books to be borrowed? (   ).

18. How many books do you borrow on each visit? (   ).

19. Do you ever use the inter-library loan service? (   ).

20. If so, how often do you use it per year? (   ).

21. If you had to pay annual subscriptions, either

    (a) for the use of a reference library; or

    (b) for the use of the inter-library loan service;

    how much would you be prepared to pay:

    (a) for the use of a reference library per annum? (   );

    (b) for the use of the inter-library loan service per annum? (   ).

22. How, in your opinion, should libraries be funded:

    (a) by making loans from the public? (   );

    (b) by local income taxes? (   );

    (c) by rates, with central Government support? (   );

    (d) entirely by Central Government? (   ).

23. What long-term expenditure would, in your opinion, best increase the long-term efficiency of a library service?

    (a) Administrative Buildings (   );

    (b) More Branch Libraries (   );

    (c) Mobile Libraries (   );

    (d) Computer Installation (   );

    (e) Larger Central Libraries (   );

    (f) Better Training of Staff (   );

    (g) Better Storage Space (   );

    (h) More Books (   ).

Please answer question 23 by ranking your preferences 1, 2, 3, 4, 5, 6, 7 and 8.

Thank you very much for your co-operation.

Table 3. Evidence from secondary data in respect of the relative sizes of reference and lending activities

(i) Frequency and Relative Frequency of Issues

Luton Data	Reference Library	Lending Library (excluding centres & schools)	Total
1970-71	43,117	1,816,768	1,859,885
1971-72	58,214	1,922,785	1,980,999
Aggregate	101,331	3,739,553	3,840,884
Relative Frequencies	(2.6%)	(97.4%)	(100%)

(ii) Relative Frequency of Other Statistics (using Cheltenham 1973-74 data).

Details of Activity	Frequency	Ratio to Issues
Reference Library Enquiries	53,134	(3.373%)
Reference Library Attendance	81,230	(5.159%)
Issues from Lending Library	1,574,518	

Notes.

1. Statistics of reference library issues are difficult to obtain, and do not include some open-shelf issues. As the lending library issues do not include some school and institution lending, the ratio between the two sets of frequencies is comparable

2. The justification for the ratios under (ii) is that even if those who attended lending libraries only borrowed one book per attendance, the relative frequency of attendance of reference libraries is low. Also reference libraries are, to some extent, matched in enquiries by the fact that comparable information is often sought in lending libraries.

3. The percentages obtained from these tables not only conform with the reference/lending stock and staff ratios of Cheltenham and Luton, but with national figures available from the L.A.R.(R.S.I.) publications listed in the bibliography.

Table 4. Evidence from the Questionnaire (Table 2) earlier in respect of the relative sizes of reference and lending functions

Question	Detail	Valid No. Replies	Comment
4e.	Books read p.a. in reference libraries	515	The mean was 3.22 but the dispersion was large, most answers being zero, but less than 10% claiming to read more than 10 books per annum in reference libraries. The ratio 3.22/42.1 is (*) 7.64%, and consisted with Table 3's ratios.
12	Visits to libraries per month	532	Mean = 3.70 Standard Deviation = 4.56 A frequency distribution appears in Table 4a. The object is comparison with question 15 re. specific visits to reference libraries.
14a 14c	Proportions of time spent in lending and reference libraries	541	These were sometimes expressed in percentages and sometimes in minutes. But the lending library/reference library time ratio was used Mean = 0.746 Standard deviation = 0.378
15	Specific visits to reference lib--raries, per year	310	Mean = 5.88 Standard deviation = 15.35 This was highly variable and the mode was much lower. But the visit ratio is (using means) 5.88/(12 x 3.70) (see 12 above) (= 13.2%). That between modes is much lower.
21a	Annual Value of reference service. This mean was calculated from responses where values were actually stated. If ambiguous zero/non-response answers are included it is lower		The mean value was £2.225, and the standard deviation 2.089. This is equivalent to respondents' esimates of only borrowing about 8 books using 441 responses.

1. Under 4e, the value 42.1 is obtained from Table 10 which gives the mean aggregate of books read per year.

2. All these response analyses show that the size and value of the reference activity is much less than that of the lending activity, and that the lending activity can thus be used as a significant estimator of total library activity.

Table 4a. Frequency Distribution of Visits to libraries per month in explanation of the data in Question 12 above

Number of Visits per Month Interval Classes	Frequency of Observations	Relative Frequency
Under 3	321	0.603
3 and under 6	127	0.238
6 and under 9	51	0.096
9 and under 12	16	0.030
12 and under 15	9	0.018
15 and over	8	0.015
Aggregate Frequency	532	1.000

Notes

1. These answers are consistent with those provided in Table 12 of the report by Taylor and Johnson: Public Libraries and their use, commissioned by the D.E.S. and published by H.M.S.O. 1973 in the following respects:

   (a) The mean is 3.70. In the Taylor report the most frequent observations are those categories of readers who visit libraries either once a week or once a fortnight.

   (b) Although the mode of the above frequency distribution is less than three visits per month, it must be considered that the Taylor and Johnson project used questionnaire responses completed by visitors to libraries during a particular week. Thus, there was a small bias against the inclusion of non-frequent users, which the earlier researchers did not need to take into account for their purposes.

2. The above distribution has some resemblance to a Poisson frequency distribution. In this respect it contrasts with that of the distribution of frequencies of specific visits to reference libraries per annum.

3. There is significant agreement with Taylor (supra) when it is considered that some readers are likely to give conservative estimates about the number of visits per month (i.e. giving between 3 and 4) while the same readers could legitimately claim to visit a library once per week.

Table 5(a) Frequency Distribution of Persons using the reference library in the 269 observation branch study

User Frequencies	Frequencies of Observations
Under 2	80
2 and under 4	59
4 and under 6	91
6 and under 8	22
8 and under 10	14
10 and over	3
Aggregate	269

Notes

1. The apparent bimodal appearance of the distribution with modal groups at 'under 2' and at '4 and under 6' derives from the number of occasions on which there were no users of the reference library. The mean is listed in Table 6, and appropriate coefficients on Table 7

2. The distribution is positively asymmetric, and the small frequency intervals for this particular table are necessitated by the small frequencies of users.

Table 5(b) Frequency distribution of persons using the non-fiction room in the 269 observation branch study

User Frequencies	Frequencies of Observations
Under 3	23
3 and under 6	21
6 and under 9	146
9 and under 12	65
12 and under 15	6
15 and under 18	6
18 and over	2
Aggregate	269

Note

In both these cases there is a significant correlation between attendances and issue frequencies, even in the case of the reference library, and even allowing for the effect of extreme values of an asymmetric distribution. The coefficients are 0.648 and 0.862 respectively where n = 269.

Table 5(c) Frequency distribution of numbers using the fiction room in the 269 observation branch study

User Frequencies	Frequencies of Observations
Under 3	16
3 and under 6	29
6 and under 9	118
9 and under 12	74
12 and under 15	18
15 and under 18	12
18 and over	2
Aggregate	269

Table 5(d) Frequency distribution of books issued on loan at half-hour intervals concurrent with observations in 5(a)-(c)

Books issued within a half-hour period	Frequency of Observations
Under 20	11
20 and under 40	32
40 and under 60	78
60 and under 80	103
80 and under 100	34
100 and under 120	8
120 and over	3
Aggregate	269

Notes

1. These tables confirm the relative frequency ratios given in Tables 3 and 4, but use primary data, i.e. frequency counts made at a branch library. The data in respect of issues was obtained by borrowing a book on arriving at the library, making the person-counts within the half-hour period, and borrowing a second book on departure. The number of issues that had been made during the half-hour period was obtained by deducting the former ticket number from the latter.

2. It is again observable that there is a correlation of 0.585 between fiction library attendance and issues where n = 269.

Table 6. Means and Standard Deviations of Frequencies given in Tables 5(a) to 5(d), i.e. 269 observation study

Variable	Mean	Standard Deviation
Reference Room Attendances	3.3197	2.282
Non-fiction Room Attendances	7.6617	2.755
Fiction Room Attendances	8.5911	2.656
Lending Library Issues (in half hour periods).	66.8141	12.183

Table 7. Correlation Matrix, giving the coefficients for 269 observations, together with comparable coefficients from a 40 observation study at a non-photocharging library

	Reference Attends.	Non-fict. Attends	Fiction Attends	Issues
Reference Room Attendances	1.000 (1.000)			
Non-fiction Room Attendances	0.759 (0.631)*	1.000 (1.000)		
Fiction Room Attendances	0.781 (0.631)*	0.741 (*)	1.000 (1.000)	
Lending Library Issues (in half hour periods).	0.648 0.578	0.862 (0.617)*	0.585 (0.617)*	1.000 (1.000)

Notes

1. Where possible, the non-photocharging library equivalents are given in brackets.

2. There was no distinction between fiction and non-fiction rooms in the latter case so the frequencies were combined. for the purpose of correlation. Thus two coefficients are identical and one indicated (*) was not possible

3. The tables show that the scale of activities of reference and lending are 3.319/(7.662 + 8.591) = 3.3/16.2 = only 20%. This supports the data in Tables 3 and 4, and the high correlation coefficients indicate that lending library activity is a valid estimator of total activity and benefit.

Table 8 The two-way association between borrowing frequencies and readers' estimates of reference and inter-library loan benefits as annual monetary equivalents

4c \ 21a (21b)	£1 & under	£2	£3	£4	£5 & over	Total
	(values were only approximate)(*)					
Under 20	121 (123)	13 (10)	19 (12)	- -	- -	153 (145)
20 and under 40	61 (72)	72 (71)	12 (8)	3 -	11 (6)	159 (157)
40 and under 60	6 (14)	16 (12)	7 (10)	15 (13)	17 (11)	61 (60)
60 and over	7 (6)	10 (8)	19 (22)	10 (9)	22 (19)	68 (64)
Total	195 (215)	111 (101)	57 (52)	28 (22)	50 (36)	441 (426)

(*) Answers were usually provided to the nearest pound

Key and Notes

1. The value categories answer questions 21a and 21b respecting (i) readers' estimates of annual benefits of reference service and (ii) readers' estimates of annual benefits of inter-library loan services.
2. The latter values are shown in brackets.
3. The vertical categories represent books borrowed per annum, and answer 4c
4. Most respondents gave the same answers to both questions.
5. The calculation of chi-squared statistics is rendered difficult because three of the cell-categories are less than 6 in frequency, however:

   Excluding these three categories the statistic would be

$$\frac{54^2}{67} + \frac{26^2}{39} + \frac{1^2}{20} + \frac{10^2}{71} + \frac{32^2}{40} + \frac{8^2}{21} + \frac{7^2}{18} + \frac{21^2}{27}$$
$$+ \frac{1^2}{15} + \frac{1^2}{8} + \frac{11^2}{4} + \frac{10^2}{7} + \frac{23^2}{30} + \frac{7^2}{17} + \frac{10^2}{9} + \frac{6^2}{4} + \frac{14^2}{8}$$

   =219.9, which is significant at 1% and 5% levels for either 12 or 9 degrees of freedom (i.e. 12 - 3)
6. A 2 x 2 chi-squared test using the '60 and over' and '£5 and over is highly significant: chi-squared = 68 with only 1 degree of freedom.

Table 8a. Typical Data from Havering Borough, showing the consistency of association between issue and request statistics

Library & Year	Issues	Members	Requests	Issues/Member	Requests/Member
1970/71					
Central	478555	15423	10931	31.0	.709
CollierRow	326003	7636	3885	42.7	.509
Elm Park	238362	5299	3543	45.0	.669
Gidea Park	268581	6229	4330	43.1	.695
Harold Hill	243601	6026	3219	40.4	.534
Harold Wood	182538	4175	2395	43.7	.574
Hornchurch	480475	9275	5555	51.8	.599
Rainham	183671	6082	2108	30.2	.347
South Hornchurch	134584	3387	1255	39.7	.370
Upminster	494871	11372	7331	43.5	.645
1971/72					
Central	479165	19276	10769	24.8	.559
Collier Row	315868	10713	3736	29.5	.349
Elm Park	221503	7785	3456	28.4	.444
Gidea Park	266569	7848	3585	34.0	.456
Harold Hill	225457	8303	2593	27.1	.312
Harold Wood	176654	5132	2219	34.4	.432
Hornchurch	480804	13653	5847	35.2	.428
Rainham	195820	5815	2096	33.6	.361
South Hornchurch	125199	4507	1182	27.7	.262
Upminster	494336	14424	6696	34.2	.464

Notes

1. The above data is illustrative only and included:

   (i). to show that the inter-library service activity is part-correlated with issues, and is a relatively small activity in comparison with it.(Hence, bookloan statistics can be used as a powerful estimator of inter-library service benefits, quite apart from detailed statistics of the latter);

   (ii) to illustrate that the ratio between requests and issues (and hence between their estimated benefits)is usually less than 2%, and that the correlation between the two types of benefits is, in any case, sufficiently high, to do so, when Central Library statistics are excluded. Even when included rank coefficients are 0.9.

2. The values of issues per member are consistent with those provided by respondents to the two questionnaires, see particularly Table 11, and also Table 8 (supra), the higher 1970/71 values having been affected by junior borrowing.

Table 9 A Summary of Answers to the Questionnaire (Table 2).

Question	Detail and Comment
1	See Table 10 for frequency table
2 & 3	Included as a check on the representativeness of the sample. The answers are not significant.
4	See Tables 4 & 11 for relevant replies (i.e. those in respect of reference and lending functions). There is agreement with the results of the earlier questionnaire (Table 1a).
5.	Out of 329 valid responses (many simply ticked one of the sections, despite the request to rank preferences) the answers of first choice were (a) 99 (30%); (b) 102 (31%); (c) 79 (24%) and (d) 49 (15%). Although there was a slight preference for (b) a percentage of each book borrowed in terms of value, this was not significant as the Friedman test showed when applied, (i.e. the two-way non-parametric rank test).
6	See Table 9a.
7,8 & 9.	Included to check the representativeness of the sample. Answers do not differ from published data.
10	See Tables 9a and 9b.
11	Aggregate proportions were (a) 28%; (b) 24%; (c) 23%; (d) 18% and (e) 7% This does not differ significantly from the distribution of popular titles.
12 - 15	See Table 4
16 - 18	This is discussed in the text.
19 & 20	In the case of 19 there was a high proportion of non-response, while only 35% of respondents answered 20, the mean rate of inter-library request usage being only 0.4 books per annum. For all readers it is probably less See the data in Table 8a for example.
21	Answers are provided in Tables 4 and 8
22	This was asked simply for an assessment of public opinion. Ranking is normal
23.	Most respondents preferred (h) more books; with larger central libraries (e) and more branch libraries (b) as next preferences. Administrative buildings (a) and computer installation (d) were distinctly unpopular.

Table 9a. Unadjusted Answers to Question 6. Estimates of Loan Value expressed as a proportion of Book's Value

Interval Class	Frequency	Relative Frequency
Under 10%	82	0.17
10% and under 30%	155	0.32
30% and under 50%	179	0.37
50% and over	67	0.14
Aggregate	483	1.00

Note

This table does not differ significantly from those in Table 1a except in the lowest category, probably reflecting a shift of valuation in the context of increasing prices between the periods in which the two questionnaires were administered. However, the answers were not entirely consistent with those of questions 10 and 11 when matched, for if the modal value of a book is £4 (using data), not more than about 40% would be prepared to pay under 75p for the loan of each book borrowed. Yet actual valid (478) replies to Question 11 were:

(a) Under 75p , 325. = (68%)
(b) 75p & under £1.50p, 110 (23%)
(c) £1.50 and over, 43. = (9%)

Table 9b adjusts (i) by using valid (i.e. consistent) replies to questions 6, 10 and 11, and by supplementing other replies using the data from question 11.

Table 9b. An adjusted frequency distribution, giving estimates of loan value as a proportion of a book's value

Interval Class	Frequency	Relative Frequency
Under 10% (e.g. approx. under 40p)	116(*)	0.55
10% and under 30% (e.g. between values of 40p and £1.20)	70	0.33
30% and under 50% (e.g. between values of £1.20 and £2.00 approx)	21	0.10
50% and over (approx. £2 and over)	3	0.02
Aggregate	210 (*)	1.00

Note (*) Fully inconsistent answers to 6,10 & 11 excluded

This table provides a conservative and realistic estimate of the average value of a bookloan to an average reader. The mean of the distribution is 11% x £4 = 44p, but the point-estimated mode is lower (i.e. 36p). This is used in later chapters (augmented for other, e.g. reference benefits) Note that the value 116 (*) is greater than the 82 of Table 9a, for it was augmented by reference to answers to Question 10, and also included some zero replies omitted from Table 9a.

Table 10. Frequency Distribution and Relative Frequency Distribution of Books Read per Annum

Class Interval	Frequency	Relative Frequency
Under 20	152	27.1
20 and under 40	161	28.6
40 and under 60	123	21.9
60 and under 80	45	8.0
80 and under 100	32	5.7
100 and over	49	8.7
Aggregate	562	100.0
('200 and over' sub-class)	(19)	(3.4)

Notes

1. Although there were 607 replies, in 45 cases answers were either 'not known' or left blank.
2. The mean frequency of books read per annum was 42.1, but the mode was near 30, as the table shows, the group '20 and under 40' actually containing the mode.
3. Most answers in the last class were either '100', 'about 100', '100+', '150' or '200'. Thus, because of the importance of the '200 and over' subclass on the mean of the distribution, it has been shown in brackets at the foot of the table.

Table 11. Frequency Distribution and Relative Frequency Distribution of Books borrowed from Public Libraries per annum

Class Interval	Frequency	Relative Frequency
Under 20	217	39.2
20 and under 40	189	34.2
40 and under 60	64	11.5
60 and under 80	32	5.8
80 and under 100	30	5.4
100 and over	22	3.9
Aggregate	554	100.0
('200 and over' subclass)	(4)	(0.7)

Notes. 1. There were less answers to this question (554).

2. Although the mean of this distribution was 32.9, the mode was lower (about 19), the mean having been affected by the very large borrowing of the most frequent category (i.e. 100 and over). The ratio between the modes 19/30 (=63%) accords with that of the control group in the earlier research project (See Table 1a (= 62%)).

PART II. CAPITAL EXPENDITURE AND THE ISSUE VARIABLE

Chapter Two. An Analysis of the Causes of Variation of the Issue Statistic to assess their relative importance

2.1. Introduction

This chapter commences the second part of the thesis and examines the causes of variation in the frequency of issues (and of issues per capita) by employing the following methodological steps:

(i) first, a tabula rasa approach is adopted, that is to say, a clean sheet is taken, and all the empirical means are used to categorise the causes of variation in the rate of issues per capita, without reference to or discussion of the pre-existent theoretical explanations, and these are discussed so that the causes of specific and occasional variation can be isolated and eradicated, and the more general factors retained for model-building;

(ii) the work of some academics is then considered so that the important regressor variables can be retained for model building;

(iii) an historical study follows, involving time series analysis of the 'issues per capita' and issue statistics, to assess the probable effect of capital expenditure on the issue statistic in Great Britain as a whole; and then

(iv) the model is further refined by considering the effect of social class and revenue expenditure on the issue statistic by:

(a) summarising work undertaken in the earlier thesis (6) to relate revenue expenditure to the issue statistic; and

(b) discussing other evidence that has become available on the effect of revenue expenditure on the issue statistic, since the completion of that thesis.

Finally, before proceeding in subsequent chapters to consider specifically the data used in the current research, those of the English counties, I shall end the present chapter by examining the probable effect of capital expenditure on the issue statistic, using the data from the previous thesis (6) for, although the examination of the effect of capital expenditure on the issue statistic was not one of the terms of reference of that thesis, it has provided some valuable data for the present study.

I should explain the reason for these methodological steps. Some writers have commenced by hypothesising reasons for variation of the issue statistic, for example, that issues are a function of the availability of books (45), or that they are a function of library membership (46). Because these opinions differ radically from each other, it is preferable to obtain a full spectrum of possible causes of variation before commencing analysis. The 'local' (or specific) causes of variation can then be removed from the model, and the more general reasons for variation considered with reference to all relevant data available. It is not possible to pursue these steps at great length because:
(i) the amount of later research to be recounted is considerable; and
(ii) some of the data were examined in the previous study(6).
It is, however, important to examine all possible causes of variation of the issue statistic at this stage, so that these can be taken into account when the effect of capital expenditure on the issue statistic is later considered. Thus, those regressors that have a known or calculable effect on the issue statistic can be removed from the specific domain of study, so that the effect of capital expenditure on the issue

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45. Brandon, R. The Library's Public (New Society.24.6.71.pp1092/3)
46. Stoljarov, J.N. Optimum Size of Public Library Stocks: (Unesco.Bull.Libr. XXVII.1. Jan-Feb 1973).

statistic can be studied.

2.2 Detailed causes of issue variation

In 2.3 I intend showing that the expenditure on bookstocks and the social class of the population of the immediate district where the library is situated have significant effect on the issue statistic, and that the first of these is shorter term in effect than the second. At this stage, I wish to leave aside these two temporary regressors and ask what other short-term reasons for increases or decreases of issues of books per capita, unassociated with capital expenditure, can be derived from librarians' reports, so that these may be taken into account when a general hypothesis is constructed. It is suggested that we consider variation from three standpoints:

(i) increase in the issues of books in a district;

(ii) decrease in the issues of books in a district; and

(iii) inter-district variation in the issues of books.

2.2(i) Increases in issues

From librarians' reports written between 1969 and 1975, apart from the effect of increases of revenue expenditure and of library construction, the major causes of increase in the rate of issues per capita, that is, of issues adjusted for population increase, are:

(a) the effect of junior libraries, and of schools; and

(b) the effect of the purchase of mobile libraries.

Whereas the former effect is both episodic and gradual, having a primary influence on junior issues, but a longer-term influence on adult issues, the latter effect is mainly episodic, and can be reversed if the mobile library is removed from circulation or if interest in it wanes.

The effect of a junior library, reported in two East Sussex(47)

47. R.G.T.Rowsell: East Sussex County Library, Annual Report 1969/70 page 1, para 1 (East Sussex C.C.) J.F.Saunders: Report of the East Sussex County Library 1972/3 page 4. (East Sussex C.C.)

County Library reports, those of 1971/2 and 1972/3, may be quoted in evidence. The reports of the Luton borough librarian (48) prior to its amalgamation with Bedford County, indicate that the junior library increased its mobile issues by over 200% in one year, and that the general increase of the issue statistic was mainly attributable to the interest of schools in the library.

Two other reports (49)(50) stated that issues of books to schools effected an increase in the general issue statistic when its trend would otherwise have been downward. Another (51) attributed the increase of its lending library issues to interest by schools, stating that in only one decade, junior membership and issues had risen by over 45%, while further specific reports indicate that schools' interest has the effect of increasing the issues of lending (52) departments by as much as 15% and, in one case, 23% (53) in one year.

While these increases featured prominently in librarians' reports between 1969 and 1975 , such large increases are not likely to recur once the greater involvement of schools in library usage has occurred. In this sense the change is episodic, and in those areas where schoolchildren form an optimal proportion of library members from the standpoint of usage frequency, though the trend will continue, the change is a past phenomenon.

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48. Luton Public Libraries: Annual Report of the Librarian 1967/68 to 1971/72. The statements may be verified by calculating the efficiency of stock usage in the junior mobile library, and comparing it with the general efficiency of stock usage over 6 years.
49. Lindsey and Holland County Library: Annual Review 1969/70, page 3.
50. G. Davies F.L.A: Flintshire County Council, Annual Statistical Report of County Librarian 1972/3 (Flintshire C.C. now Clwyd, page 1 para 4.)

Because it is past, this episodic change cannot be used in model-building for future planning, except in places where it has not occurred. It must be noted so that it can, wherever possible, be identified and isolated. But the effects in different areas are non-identical unlike the second cause of increases of issues that has featured in librarians' reports, the purchase of mobile libraries.

Mobile libraries have already been seen to affect the issue statistic in the case of Luton (48). In the cases of Clwyd, Lincolnshire and Hertford libraries their performance in particular years was noted by librarians. In one of these cases a county mobile library was reported as achieving $1\frac{1}{2}$ million issues in a year (54), and in a fourth case the mobile library had an outstanding achievement even when restricted to the loans of adult books, but the librarian stated that there would have been much better achievement if a junior mobile library had been operative (55), and other reports drew attention to the effect of(56) voluntary help on mobile libraries, particularly in respect of collection and delivery of books to housebound cases (57).

All reports mentioned other factors, and occasionally mentioned the three major sources of variation, social climate, revenue expenditure and new library construction,

51. W.S.Haugh BA,FLA: The City and County of Bristol Cultural Committee Report; The City Library 1968/71, page 17 (County Borough of Bristol).
52 G.Davies FLA: Flintshire County Council - Annual Statistical Report of the County Librarian 1972/73 page 1. (Flint County Council - now Clwyd).
53. Ibid 1971/72 page 1.
54. E.H.Roberts FLA: Annual Review, Lindsey and Holland County Library, 1970/71 page 9 (Lincolnshire L.& H.C.C.)
55. W.S.Haugh op.cit. (see 51) page 16.

but these will be discussed later, as will be the effect of the increase of population and of membership of a library. Indeed a six-year survey of a large sample of librarians' reports demonstrated that where there were episodic increases in the issues of books per capita from libraries, they usually resulted from capital expenditure on branch libraries, bookstocks, mobile libraries or other facilities as I shall show later. The most important feature that emerged from this aspect of research is that there were very few specific local reasons for increases in the rate of issues per capita apart from those given.

2.2(ii) Decreases in Issues

In the case of decreases, the reverse was true. The six-year survey of a large sample of librarians' reports showed that there was greater concern to explain decreases than to explain increases. This is, in all probability, because library reports rely on the assumption of an upward trend in the statistic, and therefore pay more particular attention to explaining local exceptions. One library report attributed a decline of mobile library issues to the construction of a nearby branch library (58) while conversely another report attributed a 2% decline of branch library issues to improvement of the mobile library service (59). Other reasons were cited, such as the removal of a pedestrian crossing

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56. R.T.G.Rowsell op. cit (see 47) pages 1 & 2 (especially paragraph on 'Bexhill')
57. F.M.Gardner CBE,FLA: Luton Public Libraries Annual Report 1969/70 page 4. 'Housebound Service (County Borough of Luton).
58. F.M.Gardner op cit 1970/72, page 2.
59. G. Davies op cit (see 52) page 1.

near a library, resulting particularly in a major decline in the number of junior issues (60); the closure of a car-park because of the construction of a ring-road (61); the partial closure of a town library for various improvement purposes (62); the shorter number of opening days because one administrative year (1969/70) contained two Easter holidays (63); the scarcity of mobile library drivers possessing heavy goods vehicle licences (64); the postal strike of 1971 (65) and the power crisis from 10th February 1972 to 1st March 1972 (66). These are not the only cases that are of a specific nature. In one case, for example, a library was destroyed by a fire, and the subsequent restriction on library space in temporary accommodation had some effect on issues in subsequent years (67). Other librarians considered that colour television had, at least, a temporary effect in causing issues to decline (68).

2.2(iii). Inter-regional Variability of Issues.

Librarians' reports, as such, do not normally discuss inter-regional variability, because they are concerned with a given region. Some of the smaller ones, prepared by town librarians prior to the redistribution of library authorities, contained tables that compared the statistics of their own library authorities with those of areas with similar populations (69) but did not give reasons for any differences. As we shall see later, the researches, particularly of Groombridge (70) and Luckham (71) attribute such differences to characteristics

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60. County Borough of Southend-on-Sea: Report of the Education Committee, Municipal Year 1971-2 pp.24 (Borough of Southend).
61. op. cit. p25. Similar reasons have been given by other librarians.
62. P.D.John: Barry Public Library Report 1971, page 3. (Borough of Barry).
63. R.T.G.Rowsell F.L.A.: East Sussex County Library Annual Report 1969-70 page 1. (East Sussex).
64. Lindsey and Holland County Library: Annual Review 1972-73 page 3 (Lincolnshire: Lindsey and Holland County Council)
65. R.T.G.Rowsell: East Sussex County Library Annual Report 1970-71, page 1.

of the population itself. For example, Luckham (72) traces the inter-regional variability of the issue rate to attributes of the population disclosed by attitudes in response to questions, and these were further related to periods of school-education. The approach of Groombridge is more direct (70), and the relevant factor indicated by his study of London libraries is that book-borrowing is lowest in areas of older population with less formal education. There is a distinct correlation between formal education and social class, and my earlier (6) study included research into the inter-regional variability of the London boroughs. For this purpose I used a regression model, that indicated significantly positive partial correlation between the issues of books from the libraries of the 32 London boroughs over a period of 6 years and

(i) density of population, expressed as a reciprocal; and
(ii) the percentages of owner-occupied housing in each of the boroughs.

In neither case was the single correlation coefficient as high as was the correlation coefficient between issues of books and expenditure on books ($r = 0.637$), but the partial correlation coefficients between (i) the reciprocal of population density and (ii) owner-occupied housing, expressed as a proportion of total housing and issues and expenditure combined were between 0.5 and 0.6 for 32 observations. In the case of density of population, the best plotting was indicated by the logarithmic equation:

$$\text{Log } Y = -0.286 - 0.205 \text{ Log } X_1 + 0.653 \text{ Log } X_2$$

where Y represents issues per head of population, X_1 represents density per acre, and X_2 represents expenditure on books per

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66. Oxfordshire County Council: Confidential Report of Librarian to Library Committee 1971-72 and 1972-3 (Oxfordshire County Council).
67. London Borough of Barking: Verbal reasons given for decline in issue statistics.
68. Miss L.V.Paulin; County Library Report 1972-3 (Hertfordshire County Council).
69. P.D.John: op cit. years 1968-73 (62 above).

1,000 of population. When population density is replaced by owner-occupied housing, the relevant equation is linear, and may be expressed:

$$Y = 2.138 + 0.021X_2 + 0.063X_3$$

where X_3 represents the percentage of owner-occupied housing in an area, and the other variables are as stated earlier. The apparently low regression coefficients result primarily from the scale of measurement used for the purpose of regression. The F-ratio test was significant in both cases, and analysis of variance showed that over 60% of the variation could be explained with reference to either of these two sets of variables. This matter was pursued by making intra-regional studies of Cardiff, Bristol, Luton, Croydon, Epsom and Ewell, Havering and other library systems that existed prior to the redistribution of local government authorities. In all cases, parts of boroughs that were known to have lower-class populations, older populations, low percentages of owner-occupied housing, immigrant populations or high densities of population had lower rates of issues of books per capita than others. The docks areas of Cardiff and Bristol, the Elm Park and Harold Hill areas of Havering and the Shoeburyness area of Southend may be cited as typical examples. In a few cases, such as Camden and the Barbican area of London the density criterion was not too reliable, because it was not a good estimator of social class, but areas of high density were usually areas of low rates of borrowing per capita.

In this broad study of reports and statistics, most of the reasons for inter-period and inter-area variability have been exogenous to the model that we are considering. The

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70. B. Groombridge: The Londoner and His Library (Library Association, 1970).
71. B. Luckham: The Library in Society (Library Association, 1971).
72. B. Luckham, op cit. pages 79-81 Table 51.

reasons for inter-period variability have been episodic and specific, and the reasons for inter-regional variability have been concerned with characteristics of the populations of the areas themselves. With the exception of those given in librarians' reports that attribute branch library issue decline to the better service of a mobile library, or vice versa most of the reasons in this section of the chapter could not be used for model-building purposes. They are accidental to the model.

2.3. More general causes of issue variation

We may now continue the 'tabula rasa' approach to the problem of variation of the issue rate by considering more general reasons that have emerged either by discussion with librarians or consideration of the work of academics. We have already considered the effect of social class, but this is a regressor that cannot be altered in the short-term. Other important regressors that must be examined in detail are (i) population size and density; (ii) numbers of member-readers; (iii) expenditure on bookstocks; (iv) expenditure on employees; (v) library opening hours and (vi) capital expenditure. Research into some of these factors is recounted in the earlier thesis, but a summary of conclusions, together with further work is given below.

2.3(i). Population size and density

The 'per capita' measurement of issues is largely heuristic and one of convenience. There is an obvious high positive correlation between population statistics and aggregate issue statistics. During the years from 1969/70 to 1975/76 the correlation coefficients between aggregate population size and aggregate issues range between 0.94 and 0.97, and when these aggregates are classified by type of authority, or ranked according to size the relevant correlation coefficients (and rank correlation coefficients) for the years concerned are almost perfectly positive. If one uses the statistics of authorities that existed prior to the recent redistribution of local authorities, the coefficients are lower, because of the large number of widely differing smaller authorities that were then in existence. Thus, although the correlation coefficient between these two variables for the 56 old counties of England and Wales was 0.979, that for the 126 non-county boroughs of England and Wales was only 0.871. Thus one is led to suspect that the variation of aggregate issues cannot be attributed to differences of population size, and this is evidenced by the range of issues per capita, varying from 7 to over 22, as we shall see later.

But this 'obvious' effect may overshadow a study of a secondary effect of population size on issues per capita. We may ask whether there is an optimum size of population of authority from the standpoint of issues per capita. In London, boroughs that have high issue rates per capita have low populations and, conversely, those that have low issue rates per capita have high populations, but this is because the absolute range of area sizes (e.g. in hectares)(72a) of the 32 London boroughs is considerably less than the absolute range of population values, and hence population size differences are merely a reflection of population density. As population density is a 'reciprocal' indicator of social class, we may suspect that the negative correlation coefficient between population size and book issues per capita is a reflection of the effect of class differences already discussed under 2.2(iii).

Outside London, an interval-class study determined optimum size of population from the standpoint of issues per capita. By dividing population into size-interval categories, and comparing the frequencies of 'issues per capita' values, the optimum size of population was the category '300,000 and under 950,000', but this was not because of any direct effect of population on issues, either in the case of pre-redistribution or of post-redistribution local authorities, but because smaller authorities were

(72a). Some of the central London boroughs are, of course, geographically smaller than the suburban ones, but this even supports the argument of relationship between population size and density, for, with the exception of the City of London (which has only a small residential population, and I have deliberately excluded) these are small, highly-populated and dense.

less well stocked, and in the case of counties sometimes included rural districts, whereas very large authorities suffered from some administrative diseconomies of scale. Also, in the case of counties, there was greater likelihood that intra-regional differences of the rate of issues per capita would not affect the mean rate where population was higher than 300,000.

The importance of this study is that it shows that although there is some population-based variation in the rate of issues of books per capita, such variation is not caused by population variability itself, but attributable to social factors, in the case of density variation, and to matters of administrative size, in the case of population size variation. We may dismiss population size from the list of causal variables, per se.

2.3(ii) Numbers of Member-readers.

Several academics discuss the increase of library effectiveness and issues, in terms of library membership. The hypothesis is that the rate of issues per head of population is more dependent on the membership proportion of the total population than on the rate of issues per library member. Because of the difficulty of measuring library usage, Alan Pritchard wrote of increasing market-share of the library, in the sense that the proportion of effective members per unit of population is a ratio similar to that of 'market-share' in industry (73). Although library membership is lower in low social-class areas than others, the variability in the proportion of library members in the population does not differ as significantly as does the issue rate. As early as 1955 F.S.Green published statistics about the percentages (74)

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73. Alan Pritchard: The Library as an Industrial Firm. An Approach to Library Management (T.C.U. 1973 pp. 7-9).

74. F.S.Green: The Missing Three-Quarters (L.A.R. pp. 392-398) October 1955.

of the population who are not expected to be public library members. This is not to say that membership does not affect the issue rate, for it must. A longitudinal study carried out by Luckham in the years 1963 and 1968 (75) indicated that membership rates at all distances from the nearest library in the Southampton area had risen because of extended tickets and improved services, and an examination of the Municipal Yearbook statistics shows that the rate of issues per capita also increased during the period.

The case for merely improving membership in order to increase issues is set forward by Ju. N. Stoljarov (76) of the Moscow State Institute of Culture. He argues that bookloans per member is not a highly variable statistic, and its small variability simply a function of differences of individual attitudes to reading.

His research paper is concerned with management ratios used by Soviet librarians to assess the effectiveness of bookstock sizes. After considering the general statistics of the U.S.S.R. Stoljarov proceeds to assess three measures of library stock effectiveness: (a) books per reader; (b) loans per reader; and (c) unit loan frequency. To illustrate the operation of these ratios he uses data taken from Narodnoe hozjajstvo SSSR v 1968 (The National Economy of the U.S.S.R. in 1968). (77)

While his management ratios are evidenced as sound ratios, given the limitations of 'per capita' statistics, that I shall discuss later, Stoljarov's statements about issues per capita must be examined critically in the light of the model that is being

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75. Luckham, B. Five Years on: Res. Librarianship pp. 157-163, September 1969.

76. Stoljarov J.N. Moscow State Institute of Culture: Optimum Size of Public Library Stocks. Unesco Bull. Libr XXVII.1. Jan-Feb 1973

77. Narodnoe hozjajstvo S.S.S.R. v 1968 Statisticeskij ezogodnik: (Moscow 1969) pp. 708-9.

proposed in this thesis.

He states that:

(i) in the U.S.S.R. 'the number of loans per reader in public libraries has stood at around nineteen to twenty' but that 'there has been a constant but extremely slow increase'; and

(ii) 'in European libraries the number of loans per reader has also been relatively stable over a period of years' but 'lower as a rule than in Soviet libraries'. The latter statement is certainly not true of the United Kingdom, and although it may be true of some European countries, is not true of others, nor of Canadian and Japanese statistics studied by the writer of this thesis.

He then argues that:

(i) the loan statistic per reader could not be much higher because of the limited time that is available for reading and leisure; but that

(ii) there may be some variability in the number of books read per person per year because of differences of input material and reader quality.

He cites in support of his statements:

(i) the conclusions of Rubiakin (78) using social research methods relating to leisure, literacy and reading speeds over 60 years previously , that 'the reading capacity of a person who had achieved an average standard of university education could not exceed 40 books per year'; and

(ii) those of Kuruc (79) relating to Czechoslovakia that persons 'who spend on average 374 hours per year on reading will either read 15 or 35 books per annum, depending on whether they are peasants or intellectuals'.

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78. Rubiakin, N.A. 'Krug znanij. Nastavlenija k vyboru krig dlija tovarisceski samoobrazovatel ni bibliotek' St. Petersburg 1909 p. 6.
79. Kuruc, A 'Razvitie ctenija v slovakoj derevne' (Bibliotekovedenie i bibliografija za rubezom' - Moscow) 16: 1965, pp. 93-94.

It must be noted that although Stoljarov's management ratios cannot be gainsaid, his statments about the issue statistic suffer from the weakness that they are not only based on incomplete data, but on dated research data and methods. His sample statistics do not include the United Kingdom, where library loans per member alone, without the aggregation of non-library material, are as high as 40 books from branch libraries and 69 from some mobile libraries (80)

Nor does Stoljarov mention or use empirical data in respect of individual readers. I showed in chapter 1 that readers' responses to questionnaires indicate that some readers, particularly students, may, even allowing for hyperbole and inflated responses, read as many as 150 or even 200 books per annum. These individual reader-estimates are not unreasonable. The number of books that people read, even for non-professional, non-academic reasons is considerably higher than that postulated by Stoljarov. Sandison and Preskett carried out a survey of the British Library (Science Reference Library) in 1970 (81), and their questionnaire responses indicated regular visits by nearly 50% of respondents, many of whom were non-professionals conducting a personal (33%)'non-academic' interest and some remaining up to six hours. At such levels of reading considerably more than 100 books would be read by an individual per annum, and not necessarily by students and professional academics, despite the specialist nature of the library concerned and of

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80. Mobile library issue statistics will be discussed later. Investigations have tended to show that the issue rate is considerably higher than that of branch libraries, but tends to decline after initial impact.

81. Sandison, A and Preskett, M. Library Effectiveness Survey 1970. (The British Library: Occasional Publications, London 1972). Also

82. Clough, E.A. Membership for Branch Location (Res. Lib. 1967) indicates that membership data may be used for capital decisions. The variability of (82) must be considered in this context; despite such policies. (sec 117).

the type of reading, and the fact that issues represent reading carried out away from a library environment.

In conclusion of this section, it has not been possible to pursue at very great length the argument that issues are mainly a function of library membership, and that the enhancing of library membership size will necessarily increase issues. It is clear that the attributing of issues to membership is simply a one stage removal of the problem nearer to source. Issue statistics have a much greater range of variability than membership (82) statistics, and statistics of issues per member have also a very high range of variability. The statement that no reader will read more than 35 books per year (76) has been shown to be fallacious in the United Kingdom context. We may dismiss membership from the list of regressor variables despite the small evidence provided (75) because it is itself a dependent variable and does not account for most of the variability of the issue statistic.

2.3(iii). Expenditure on Bookstocks.

The effect of expenditure on bookstocks on the issue statistic has already been researched in the context of London in the previous thesis (6), and it would be unnecessary duplication to state the conditions in which such expenditure affects bookstocks in the present work. County librarians' reports have sometimes attributed the decline of the issue statistic to the decline of book purchases resulting from the decline of real expenditure on books. D. Williamson(83) was quoted, in the capacity of Leeds borough librarian, as stating, as the reason for variability of issues: 'Perhaps it's a function of the amount of money we spend on new books'. This statement is evidenced by the analysis of variance of the statistic, issues per capita, with respect to expenditure on books and to density of population and house-ownership.

House ownership statistics were used as indicators of social class of an area, and the two regression equations that best approximated the data for given years were provided in 2.2(iii). The matter was pursued at much greater length, and a six year study of the London boroughs showed that issues of books were affected by expenditure on books more than by quantities of bookstocks purchased. The effect of inflation was isolated by constructing an index of price/quantity ratio increases relative to London and measuring the 32 London boroughs against the criteria of the index changes for each year. Then the statistic was lagged so that the effect of 1966/67, 1967/68, 1968/69 and 1969/70 on 1970/71 book issues could be studied. Similar techniques were used for the issues of the previous years in the sequence. In general, although it was seen that the correlation between issues per capita and expenditure on books (per capita) was between 0.6 and 0.7 when the variables were paired for any pair of differing (or similar) years, there was also a significant 'lag' correlation coefficient (0.35) between increases of expenditure on books per capita and increases of issues per capita (or vice versa) when the two variables were lagged by one year, hence expenditure in 1969/70 had a marked effect on 1970/71 issues. Further,

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82. Issue statistics vary from 7 to 25 per capita; membership proportion varies between 25% and 40% of population, and issues per member from 20 to 69 as arithmetic means for particular libraries. Thus library membership is the less variable as an inter-library statistic than the other two variables. It is true that between classes of population there is high variability in library membership e.g. unskilled manual 8% (83); university education (74%) but (i) these statistics are dated and (ii) there is even greater variability (between 1 and 200)in annual borrowing per member.

83. Brandon, R. The Library's Public. New Society 24 June, 1971

it was again shown that expenditure on books had a greater effect (in terms of increments or proportionate reductions of quantities, monetary values and real values) than did quantities of books purchased. Finally, a comparison of periodic changes in the variables over six years, using, for example, values such as:

$$\frac{\text{Expenditure on Books per Capita, 1970/71}}{\text{Expenditure on Books per Capita, 1966/67}} \text{ ; and}$$

$$\frac{\text{Issues 1971/72}}{\text{Issues 1967/68}}$$

confirmed the lag effect of expenditure on books (84a) on the issues of books. Although details of this study have been given elsewhere (6) further research has shown a similar effect in the case of the English counties. In this case, although growth of bookstocks is best approximated by logarithmic least squares (83), when prices are converted to real values a linear (84) model gives sufficient evidence of the effect for the years concerned. Thus, we must retain expenditure on books as an important variable. In the chapter on bookstocks, their effect and the extent to which they may be regarded as capital, a more detailed discussion can take place.

2.3(iv). Expenditure on Employees

The consideration of this variable arose initially in discussion with librarians. A study of the publication Public Library Statistics for the years 1966/67 to 1975/76 shows, for each year, a significant correlation between expenditure on employees (per thousand of population) and issues per capita, but there was no noticeable lag effect

83. Baumol, W.J. and Marcus: Economics of Academic Libraries (American Council on Education: Washington, 1973, Page 5, Figure 1.1).
84. Raffel, J.A. and Shishko, R.: Systematic Use of University Libraries (M.I.T. Cambridge, Mass 1969, page 45, Figures 11 et al).
84a. After adjusting the variable to isolate the effect of social class in the manner described in Chapter 8 of this thesis.

in the changes (increments or reductions) -of the variables. The correlation coefficients between the variables themselves were never more than 0.4 between 1966 and 1976. For example, during the fiscal year 1969/70 the correlation coefficient between the two variables was 0.372. But these were total (i.e. absolute) values, not incremental values, and could be attributed to a jointly correlated variable. For example (i) the salaries of employees for the 32 London boroughs would be matched over time; (ii) the boroughs pursue similar policies through the Association of London Chief Librarians; (iii) there was some evidence of a reverse effect, that is, that the issues of books had an effect on the expenditure on employees, when lagged inter-year incremental changes were studied; and (iv) the variable is a composite, consisting of manual, non-manual and professional categories. Further work on the statistics for the years 1967/68 to 1975/76 showed that there is an even lower correlation between the issues of books and frequencies of manual and non-manual categories of employees, than between the issues of books and professional staff frequencies. The reverse trend stated in (iii) was not significant. This may be expected because a relatively small proportion of library staff is actually engaged in the issue of books. The expenditure on employees is thus a composite variable, and most of its factors need no further consideration, because they have been discussed elsewhere (6), but expenditure on professional staff will be discussed further in the chapter on human capital resources.

2.3(v). Library opening hours.

Suggestions made by academics at The City University at the time of research for the earlier thesis (6) did not meet the test of empirical evidence, and it was only pursued in research for the current thesis to the extent of determining the effect on issues of various types of branch libraries with varying interval categories of opening hours.

Although in some years of the period 1967/68 to 1975/76 the correlation between total opening hours of all branches of all libraries in a borough and the total issues of the branches of a borough library was high, it was never more than 0.7, and partially explained by joint partial correlation of both variables with population size. Analysis of variance of a sample of libraries showed that the remaining positive correlation coefficients (85) resulted from differences of branch library frequency rather than from differences of the mean number of opening hours for each library authority. Branch library frequency is a function of capital expenditure, while residual differences in the mean number of opening hours are a function of staffing constraints and public demand. The first of these factors can thus be subsumed under capital expenditure (in the provision of library buildings). The second factor is not significant. Empirical studies showed (86) that most readers tended to structure their library visiting times so as to coincide with library opening hours, and are therefore quite unaffected by regional differences. Most of the variability of this factor can therefore be subsumed under capital expenditure, and we may remove library opening hours, as such, from the list of regressor variables.

2.3(vi) Capital Expenditure.

The case for capital expenditure as the major variable that determines issues of books will be considered at length in future pages. The basis of the study was the discovery, while researching the effect of expenditure on books on the issue statistics

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85. In London through the period stated, although the correlation between aggregate variables is from 0.58 to 0.73, that between the variables when adjusted for units of population is from 0.39 to 0.48. London provides an ideal case for the study of this variable, for opening hours vary but libraries are proximate and tickets are interavailable. Thus, readers could travel if a library were closed, and the effect would be measurable, because of the otherwise similar policies of libraries through the Association of London Chief Librarians.

of London boroughs, that capital expenditure during the previous ten-year period had a small effect on the issue statistic. Those libraries, such as Camden and Barnet, that had comparatively high issue statistics, i.e. issued books in excess of 15 per capita per annum, had also high capital expenditure programmes. But after taking into account expenditure on books and the measurement of the social class composition of each borough's population, the partial correlation coefficient of residuals with capital expenditure (per head of population) was only barely significant, (0.35 for 32 boroughs). This is because London is relatively well-furnished with libraries, and the study therefore requires to be pursued outside the context of London. This factor affected the choice of English counties for the present study.

We can now conclude this open study of all possible major sources of variation of the issue statistic. Most of the factors that appear in librarians' reports are episodic. Causes of inter-regional variability may often include differences in the social content of the population. It has been shown that population and population density (87) are, as variables, also related to social factors; that membership of libraries as a proportion of population has usually a much smaller effect on issues per head of population than do issues per member; that expenditure on books must be retained for consideration as a variable, but that the capital aspects of expenditure on employees and library opening

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86. Questions asked interviewing a small sample of respondents subsequent to administering questionnaires detailed in chapter 1. Only 3 of 127 people would have been affected.
87. The correlation coefficients between population density and proportion of owner-occupied housing as indicators of regional mean 'social class' ranged between -0.67 and - 0.83 between 1961 and 1971 in the London area.

hours are the only features that need be retained for model-building. Thus, from the large array of variables we have selected (i) indigenous characteristics of the population; (ii) revenue expenditure on books and (iii) capital expenditure as the three variables that require consideration. I shall return to a more general consideration of revenue expenditure on items other than books in Section 2.5., but in 2.4. shall give a brief historical survey of the case for considering capital expenditure.

2.4. An Historical Study of the Rate of Issues per Capita.

Statistics obtained from a large number of sources, including Annual Abstracts of Statistics, Kelly (88), the Library Association, Municipal Yearbooks, copies of Public Library Statistics and some of the Corbett 'Yearbooks', were employed to trace the growth of the statistic 'issues per capita' for the years between 1880 to the present time. Annual statistics were obtained whenever possible, and time-intervals for the purpose of this study were never larger than between three and five years. The purpose of using 1880 is that previous statistics are not too reliable. To avoid unnecessary tabulation of data compiled compositely from secondary sources, a brief history of the statistic (88a) may be recounted. In 1880 it stood at 0.23, rose to 0.43 in 1890, to 0.75 in 1900, 1.22 in 1910 and 1.91 in 1920. It then rose significantly to 3.48 in 1930, to 5.69 in 1940, to 6.14 in 1950, to 8.83 in 1960 and over 11 in the period that will be studied shortly. This appears at first sight to be a curvilinear trend explained by logarithmic least square time series analysis, but further investigation shows that this is not the case.

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88. Kelly, T. A History of Public Libraries in Great Britain (The Library Association, 1973).

88a See Tables 12 and 13.

Instead, it must be regarded as a composite of the population and issue variables. The population variable rose constantly from 30 million to 42 million between 1880 and 1920 and then the rate began to decline, producing small steady increments to about 51 million in 1961, whereas the aggregate number of issues of books increased geometrically from 7 million to 14, 28 and 50 million respectively in the three earlier decades, but began to assume a linear trend, until 1925. Despite the apparent geometric rise in the aggregate statistics, the period to 1925 can be reasonably approximated by the time regression model:

$$Y = 7 + 1.84t$$

where Y represents the number of issues and t, the time interval (in years from 1880), - issues being in millions.

At 1925 the trend line rises sharply, but still maintains a linear (though more acute) appearance, with the relationship:

$$Y = 90 + 8.68t$$

where Y again represents the number of issues in millions, and t, the time interval in years from 1925.

In 1950 there was again an episodic change in the trend line, to a more acute linear trend:

$$Y = 307 + 20t.$$

where t is the time interval in years from 1950.

These three sharp linear trends are discernible despite the passing of a major Education Act in 1901 and the slight tail-off in reading during the Second World War, so that in 1968/69 the issues reached over 700 million inclusive of school issues, and 600 million by the estimate given in L.J.Taylor in 1970, when school issues are excluded.(89).

89. L.J.Taylor: Report on Library Statistics (The Municipal Yearbook 1970).

There are thus two episodic linear changes in the growth of issues (and consequently of issues per capita) in 1925 and 1950. These two watersheds subsist despite the passing of a major Education Act in 1901, the programme by the Carnegie Trust in 1913 and the other educational changes that could have produced significant changes in the trend of the issue statistic. The fallacy that the increase of the regression coefficient in 1925 was due to the advent of radio broadcasting, and that in 1950 to the advent of television, can be countered by the antithetic statements in some librarians' reports (68). attributing the decline of issues to television broadcasting.

On the other hand, there is positive evidence for believing that the upward change in the trend resulted from episodic changes in the capital development of libraries. Although the Carnegie Trust initiated a programme of library development in 1913 it was retarded by the First World War, but bore fruition in the Library Act of 1919 empowering Central Government grants to County Councils for library development. I show later that there is a lag of four years to account for planning, building and the effect of the development on issues. Given that the library legislation became effective in 1920, 1925 was the most probable year for it to achieve fruition. There is similar evidence to account for the episodic change in the time-regression coefficient in 1950. Programmes of library building were curtailed during the Second World War, but received poor immediate attention afterwards despite the postwar rationing of building materials. The development of mobile libraries and of temporary libraries enhanced the trend, and if the lag of four years between planning and effect is again taken into account, the most probable year for these factors to achieve effect would be 1950. Although I shall show later that mobile libraries have a greater, but less sustainable, impact than branch libraries, and although there has been a trend increase attributable to an increase in library-awareness, the only major historical factor that accounts for the increased rates of change at the time points, 1925 and 1950 , is in both cases the effect of capital development in the preceding five-year periods. If, as will be shown from developments between 1969/70 and 1975/76, capital projects have a five-year period to become effective, then there is clear evidence that the changes in the trend in 1925 and 1950 were the results of capital developments, forming the estimators of increased social income (in increased issues) as a return on library investment, and having a more pronounced long-term effect than either library awareness (allied to social factors) or expenditure on bookstocks. These two latter factors can account for the upward trend increase in the rate of issues per capita rather than for episodic changes in the trend. (89a)

2.5. The short-term effect of Revenue Expenditure.

When dealing with hypothesised reasons for changes in issues per capita in sections 2.2 and 2.3 it was decided to examine expenditure on bookstocks and on employees because these two categories of expenditure form the major components of library revenue expenditure. Other components are (i) overheads associated with the maintenance of premises; and (ii) miscellaneous expenditure. I shall show that although there is significant correlation between revenue expenditure and issues, it is largely explained by time-series, autocorrelative factors and joint correlation with other variables. Only in the case of expenditure on books is there evidence (because of incremental lag) of a direct effect of such expenditure on the issue statistic, and this is a temporary effect for the average life of a bookstock does not exceed seven years. I shall

(89a). These 'latter' factors are (i) social factors and (ii) revenue expenditure on bookstocks.

deal sequentially with the English counties (because of their importance to this study) and then with further work on statistics of the 32 London boroughs since completion of the earlier thesis (6), and use the Municipal Yearbook (1968 - 1975) statistics as the basis of analysis.

In the earlier thesis exhaustive treatment was accorded to 1970/71 statistics. For the English counties (n = 58) the correlation coefficient between population size and revenue cost (r = 0.979) was no greater than that between population size and issues (r = 0.981) but was greater than that between revenue costs and issues (r = 0.972). Large counties spent smaller proportions of their rate fund on libraries, such that the correlation between population size and the percentage of rate fund spent on libraries (r = - 0.350), and although this is significant at the 5% level of significance, for n = 58, all the coefficients can be attributed to differences of scale (population size) between variables. It is important that of the triad given earlier in this paragraph the correlation between revenue costs and issues is the lowest. (89b).

This tentative conclusion is supported by other analysis. The 171 observations of counties, county boroughs and London boroughs for the same year produced corresponding coefficients of r = 0.871, r = 0.953 and r = 0.886 respectively. The correlation between population size and issues is again the highest, and although that between issues and revenue expenditure is not the lowest in this particular case, this reversal is attributable only to the effect of the London boroughs, for when the sample is reduced by the London boroughs from 171 to the 139 counties and county boroughs of England and Wales the relevant coefficients are r = 0.950; r = 0.957 and 0.947 respectively. Finally, an analysis of the 351 pre-redistribution library authorities of England and Wales that were available for study in 1970/71 showed that the correlation coefficients were in the order r = 0.913,

(89b). See Table 14.

r = 0.966 and 0.921 respectively. In this case, (89c) the correlation coefficient between revenue expenditure on libraries and issues of books from libraries is not the lowest in the triad, because of the great differences in revenue expenditure per capita by the smaller library authorities on their libraries, prior to the redistribution of library authorities after the 1972 Act. The evidence was that within the 32 London boroughs and the smaller authorities there was greater correlation between issues and population size than between issues and revenue cost, but that the coefficient between revenue cost and population size was lowest. For the rest of England and Wales, however, comprising counties, county boroughs and the larger remaining boroughs, the correlation coefficient between issues and revenue cost was the lowest of the three.

The position is similar for most other years between 1966/67 and the redistribution years, after which it (89d) is impossible to continue the study because of lack of comparability. For the counties and county borough statistics, there is lower correlation between revenue expenditure and issues of books than there is, either between revenue expenditure and population or between population and issues of books. London remains the most outstanding exception to this general principle. In 1976, for example, I wrote the results of a small study of statistics, based on the 1975 edition of the Municipal Yearbook and published them in the 1976 edition of the Library Review (90). It showed that for 1973/74 data in respect of 30 London boroughs (2 being unobtainable) the relevant coefficients were (i) between issues and population (r = 0.731); (ii) between population and revenue expenditure on libraries (r = 0.373); and (iii) between issues and revenue expenditure on libraries (r = 0.610). This is typical of data for years 1970 - 75.

(89c). Partial coefficients are shown in Table 14, i.e. controlling for population size.

(89d). The 'redistribution years' are those immediately after the 1972 Act.

Extensive analysis, using the correlation of the values themselves, their logarithms, squares and square roots indicates little change in the rank order of these three sets of correlation coefficients for any of the years between 1967 and 1974. The evidence shows that, in the case of counties and county boroughs, there is generally a lower correlation coefficient between revenue expenditure and the issues of books than there is between either issues of books and size of population or between revenue expenditure and size of population, and that the correlation, and to some extent, the variability of issues and revenue expenditure can be generally explained with reference to partial correlation with the size of population. For small boroughs and for the London boroughs, the situation is different, and there is a higher correlation between issues of books and revenue expenditure than there is between revenue expenditure and size of population, but the variability of the issue statistics is lower, in most cases, than either population size or revenue expenditure.

The advantage of using London boroughs and small boroughs was that the population variation was less in these cases, than when using data for counties and county boroughs. Yet, much of the variation and correlation between issues and revenue expenditure can, even in these cases, be

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90 Pitt Francis, D. Cost Benefit Analysis and Public Library Budgets: Library Review 1976 Volume 25, No 5/6 pp. 189-192, Table on page 192.

attributed to differences of population size. For London, this varies between 150,000 and nearly 350,000 and therefore varies much less than the population size variable for counties and county boroughs, but the variability of population is as large as that for library revenue expenditure in London, and greater than that for issues (as an 'absolute' statistic) in London.

There are several ways by which we may proceed to study the relationship between library revenue expenditure and issues without calculating partial correlation coefficients: (90a)
(i) express revenue and issues as statistics per capita, and examine the correlation coefficients for the variables when expressed per capita;
(ii) study the relationship between revenue expenditure and issues in London boroughs of comparable population sizes; and
(iii) move outside London to study these two variables for the populations of similarly sized boroughs or other library authorities prior to the redistribution effect by the 1972 Act.

The objective in all three procedures will be to eliminate the effect of partial correlation between the variables and population size, in the first case by simple division by population size, and in the other two cases, by using the aggregate untransformed values for each of the variables, but by selecting observations from data with similarly sized populations so that the size of population is held constant.

2.5(i). London Boroughs, Variable Values per Capita.
Between the years 1969/70 and 1973/74 the coefficient of variation of issues per capita for the 32 London boroughs did not exceed 0.2, while that for revenue expenditure per capita exceeded 0.35. Thus, with population held constant, revenue expenditure is seen to be much more variable than issues of books per head of population. Thus, even if the correlation coefficient between the two variables were high,

there would be a case for separate examination of the effect of extreme values of the variable, revenue expenditure per capita on issues per capita. But, in fact, it is not high. Although the correlation coefficient is as high as 0.61 between revenue expenditure and issues, this diminishes to 0.4 for most years when both are expressed per unit of population, and when revenue expenditure is analysed into components, for example:

(a) expenditure on employees per unit of population;
(b) expenditure on books per unit of population;
(c) expenditure on premises per unit of population; and
(d) miscellaneous revenue expenditure,-the correlation coefficient falls dramatically between issues per capita and all these components of revenue expenditure except expenditure on books.

For example, for the years studied (1969/70 to 1973/74) they do not exceed the following values:

(a) between issues per capita and expenditure on employees per unit of population, $r = 0.372$;
(b) between issues per capita and expenditure on books per unit of population, $r = 0.637$;
(c) between issues per capita and expenditure on premises, $r = 0.352$; and
(d) between issues per capita and miscellaneous revenue expenditure, $r = 0.251$.

If Fisher's transformation of the correlation coefficient is employed for values of the t-statistic comparable with coefficients of correlation where $n = 32$, none of the values with the exception of those given under (b), i.e. books, is significant at the 1% level of significance, and only two of the three are even barely significant at the 5% level of significance. Even if the coefficients had been higher for the other components of

(90a). That is, partial correlation coefficients between revenue expenditure and issues, controlling for population size (Table 14). Some coefficients are significant, but there is poor significant association for counties and these have the highest populations.

revenue expenditure, they could be explained by reference to expenditure on books, by stating, for example, that expenditure on premises and on employees is necessary in those boroughs where issues of books are high, in order to maintain the service required to meet high demand for books. Further, although there is evidence of a time-series lag between increments and reductions of expenditure on books and the issues of books (both variables expressed per head of population), there is no evidence of a forward lag for any of the other components of revenue expenditure. We may, from the evidence presented in this section, conclude that there is no evidence that revenue expenditure has a highly significant effect on the issues of books per capita, except by reference to expenditure on books, a matter already dealt with fully in the previous thesis (6).

2.5(ii). London Boroughs, Variable Values for Comparable Sizes

Instead of dividing issues and expenditure by population size, we may obtain some evidence by calculating correlation coefficients for the relationship between the variables themselves and then stratifying the 32 London boroughs into two subsets, the 16 larger boroughs and the 16 smaller boroughs. Thus population differences are reduced, but the samples have small size ($n = 16$) and the t-test statistic must be applied in all cases. At least, this study has the benefit of indicating whether the correlation between revenue expenditure and issues is greater for larger than for smaller boroughs. The results are interesting. For example, in the case of 1971/72 data the correlation coefficient between issues and gross expenditure is 0.412 ($n = 32$), but is greater for larger boroughs, 0.517 ($n_1 = 16$) than for smaller boroughs, 0.493 ($n_2 = 16$).

The correlation coefficients between issues and net revenue expenditure on libraries (i.e. expenditure less fines, rents receivable and other small income items) are similar, but correspondingly lower, i.e. 0.385, 0.492 and 0.471 respectively. For most variables the coefficients for the subsets were numerically greater (though less significant, for n_1 and n_2 = 16, while n = 32), but for population the coefficients (i.e. between issues of books and population) were lower for the subsets, because of the reduced population variability, i.e. respectively r = 0.730, r = 0.492 and 0.412, and similarly the correlation coefficients for the subsets of the 32 boroughs (16 each) were lower for the correlation between total library hours, (i.e. 0.636, 0.321 and 0.389 respectively) and total issues for the boroughs concerned. The reason for the lower coefficients for the subsets of 16 boroughs in respect of population and issues was obviously due to smaller population variability, and the lower coefficients between total opening hours of all libraries and issues is explained by reference to the fact that opening hours are a function of the number of libraries in each borough and that this is, in turn, a function of size.

When boroughs of comparable size are used in correlating issues with other variables, few of the coefficients are significant for the size of samples taken. Both premises and expenditure on employees cease to be significant, but the coefficients in respect of correlation between issues and 'book' variables are significant even for 16 observations. In the case of 1971/72 data the correlation between issues and (a) bookstocks; (b) book purchases and (c) non-fiction purchases are 0.771; 0.790 and 0.513 respectively, where n = 32. For the 16 larger boroughs the corresponding three correlation coefficients are respectively

0.416; 0.618 and 0.506, while for the 16 smaller boroughs they are respectively 0.572; 0.620 and 0.538. Thus, although sample size is the same and the critical levels of the coefficient identical for the two sets of 16 comparably sized boroughs, the correlation coefficients for the smaller boroughs between issues and 'book' variables are higher than those for the larger boroughs. This can be explained partly by reference to the type of population in the smaller boroughs, to the conclusions of the earlier thesis (6) that social class varies inversely with both population density and with the size of borough. The important conclusion from this aspect of the study is identical with that of 2.5(i), that there is little evidence that revenue expenditure on libraries (as a composite) produces a greater number of issues (either in total or per capita), except with reference to revenue expenditure on the purchase of books. For most years (as for example 1970/71) there was even a higher correlation between issues of books and fines (r = 0.696) than between issues of books and net revenue expenditure, despite the disparities in amounts of fines and the methods of collection.

Before proceeding to deal with the correlation between revenue expenditure on libraries and the issue statistic for boroughs of similar populations outside London, I should state that a further study was made of a single borough, Camden over a number of years (1965 and 1974) using pairs of variables and having both (a) contemporary values and (b) values lagged by one year. The lagged and unlagged cases were not significantly different from each other. The correlation coefficient between purchases of books per reader and issues per reader was 0.727, while that between library expenditure per reader and issues per reader was only 0.496.

There would be little validity in an argument based entirely on the time series correlation of the three variables for one borough, because there would be no method of identifying the lag effects of revenue (90b) expenditure generally and of expenditure on books. But the argument carries much more weight, when it is recognised that the coefficients are so widely different despite (i) the fluctuation in expenditure from one year to another during the period, because of changes in Government policy; and (ii) the normal budgetary tendency to hold the proportions of revenue expenditure on each category as stable as possible despite the changes in the amounts of money available. Expenditure on books has the highest variability in time-series terms, since additional revenue funds are usually deployed replenishing bookstocks and shortages in any one year cannot involve the 'cutback' of employees' salaries, for example, for they are determined by binding agreements. Thus, the impact of inter-year variability of revenue expenditure is best illustrated in the case of expenditure on books but despite this fact the correlation coefficient between issues per reader and purchases of books per reader is considerably higher than that between issues per reader and revenue expenditure per reader. The evidence from this, and from the previous section, suggests that revenue expenditure on libraries does not affect the issue statistic, except in respect of revenue expenditure on bookstocks.

2.5(iii). Studies from other similarly-sized boroughs

We are now in a position to test the hypothesis that there is no significant correlation between revenue expenditure and the issue statistic, except in respect of bookstocks, by studying a sample of cases outside the 32 London boroughs. The purpose in using small boroughs outside London rather than counties and county boroughs must already be apparent from the

(90b). Except, of course, for testing whether autocorrelation is present, e.g by using the Durbin-Watson statistic.

introduction to 2.5. It is that in the cases of counties and county boroughs the correlation coefficients between revenue expenditure and issues are consistently lower than they are between both issues and population and between revenue expenditure and population. The only possible prima facie justification for the hypothesis that there is a significant correlation between revenue expenditure and issues came, as we saw in the introduction, from a consideration of the 32 London boroughs and of the smaller English and Welsh boroughs. The effect of these library authorities on the original sample appeared to indicate that there may have been correlation between revenue expenditure and issues. In 2.5(i) and 2.5(ii) it has been shown that the evidence from the 32 London boroughs is much weaker than may have been apparent from the original study in 2.5. It is thus not necessary that we now examine counties and county boroughs where there is, in any case, no strong evidence for such correlation, but we must instead examine some of the smaller town boroughs that existed prior to the redistribution legislated in the 1972 Act.

Prior to this Act, there were 351 library authorities in England and Wales, but as the study of London boroughs has shown population differences can affect correlation coefficients, and the simple expression of statistics 'per capita' (i.e. per head of population) does not solve the problem of correlation, because of general lack of comparability between differently sized boroughs and other authorities. It has already been seen that a difference of 100,000 can have a significant effect on the correlation coefficients even when examining authorities that range from populations of 150,000 to 350,000 not simply because of the size differences themselves, but because of differences in the characteristics of populations of dense, as against sparsely populated areas.

It was impossible to find a suitably large sample of library authorities whose population-sizes were so similar that a test involving the normal distribution could be applied. The nearest approach that could be made to obtaining a useful sample of boroughs of comparable sizes was in the interval category '40,000 and under 50,000'. The actual category was even narrower. A sample of 17 library authorities was obtainable whose populations ranged from 40,000 to 47,999 during the period from 1968 to 1972, but some of these were changed during the study and others were substituted where the population exceeded 48,000. The results were confirmed by including the cases in the subcategory 48,000 and under 50,000. The list included Altrincham, Barry, Batley, Dartford, Eccles, Folkestone, Hereford, Kidderminster, Leamington Spa, Maidenhead, Morley, Port Talbot, Scarborough, Swinton, Tunbridge Wells, Weston-super-Mare and Weymouth.

Because the sample size was reduced to 17 minimally and 21 maximally, and because this sample was insufficiently large for tests involving the Normal distribution despite the fact that observations involved time-series values between 1968 and 1972, tests of significance involved Fisher's values of <u>t</u> and the transformation of the correlation coefficient. If 17 pairs are used, the number of degrees of freedom (ν) is 15, and for two-tail tests the critical values of the correlation coefficient at the 5% and 1% levels of significance are respectively 0.4821 and 0.6055. They are higher for one-tail tests, but this consideration is not relevant to present discussion.

Using this sample of comparatively sized boroughs, it was seen that in the four years from 1968/69 to 1971/72 the correlation coefficients between revenue expenditure and the issues of books from libraries were respectively 0.557, 0.376, 0.083 and 0.068. Of these coefficients, none is significant at the 1% level of significance and only one is significant at the 5% level of significance. The correlation coefficients between revenue expenditure and books purchased are respectively 0.052, 0.195, 0.381 and 0.459. None of these is significant at either the 5% or 1% levels of significance. On the other hand, despite the inter-year variability of expenditure on books and purchases of books that was explained in the case of London in the previous section, the correlation coefficients between issues of books and books purchased were respectively 0.409; 0.310, 0.402 and 0.623. As the sample sizes exceeded 17 in the earlier years, the correlation coefficients approached the 10% level of significance in three of these cases, and exceeded the 1% level of significance in the case of 1971/72. Further, it is seen to be more stable despite the wide changes in revenue expenditure during these years. In other words, there is again evidence of a small correlation between bookstock purchases and issues, and if the results of the earlier London study (6) may be applied, this is evidence of an effect of bookstock purchases on issues rather than that of issues on bookstock purchases; but there is no evidence of a signficant effect of revenue expenditure on the issue statistic.

Finally, in this case as in that of London, I decided to use the statistic of one authority and correlate the three variables, issues, expenditure on all categories and on bookstock purchases. Data were obtainable for the years from 1967/68 to 1972/73 and showed that, after adjusting for inflation, the time-series correlation coefficient between revenue expenditure and the issues of books was only 0.52, and therefore insignificant at the 5% level of significance, while that between bookstocks and issues was 0.71 and that between book-purchases and issues was 0.83.

2.6. Capital Expenditure and the Issue Statistic

Before proceeding to summarise the discussion in this chapter , it is useful, as I indicated at the outset, to outline the probable effect of capital expenditure on the issue statistic. The major detailed account of this investigation will form later chapters, but from the study of London boroughs (6) certain features became apparent that showed that the issue statistic was not only affected by expenditure on books and by the social intrinsic characteristics of the populations of the library authorities concerned, but that there was a lagged direct effect of capital expenditure on the issue statistic. This was not pursued in the earlier thesis (6) because it required more rigorous study, not only in respect of London but as a general principle.

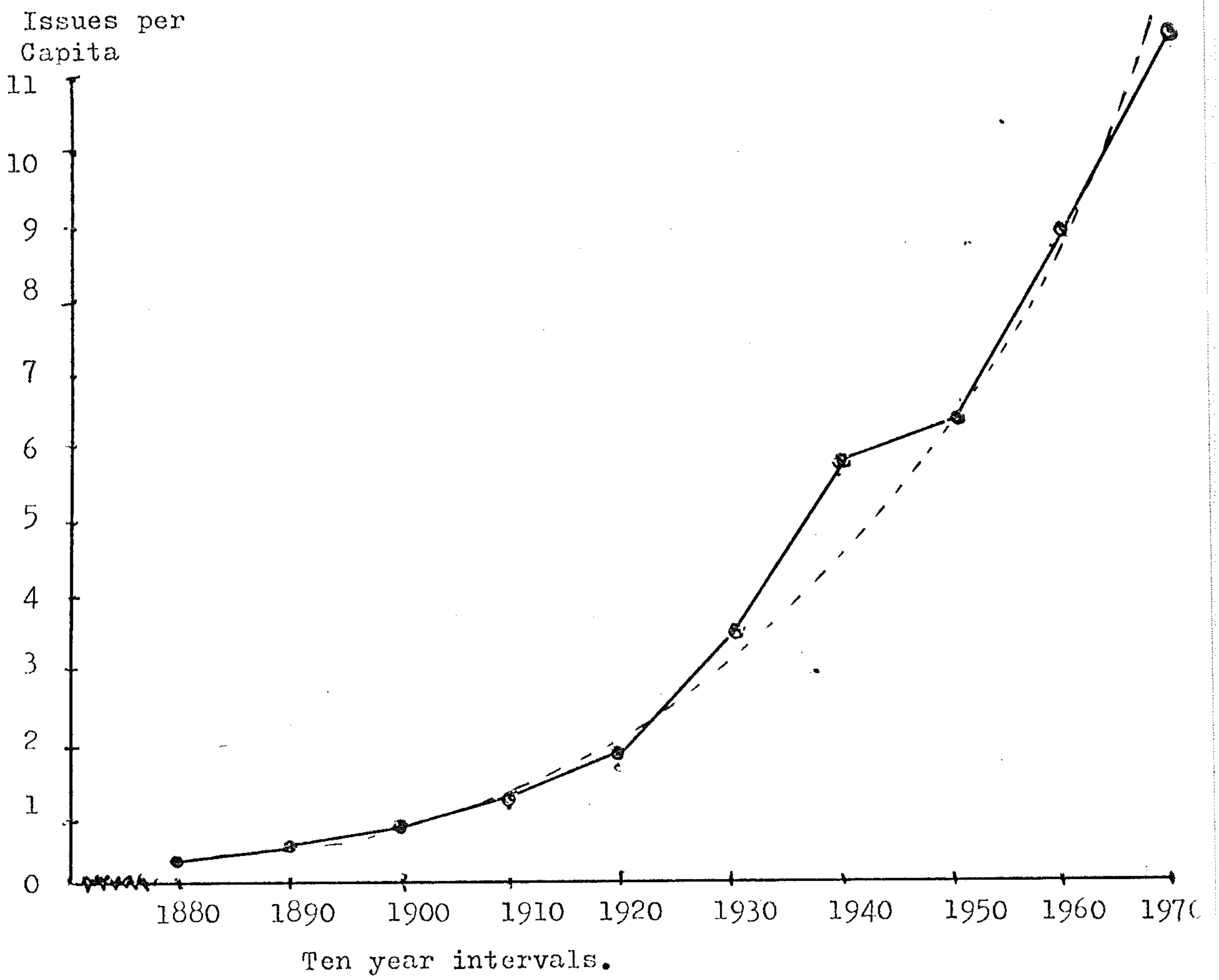
A more recent study along the same lines has shown, for example, that if the sums spent on library buildings in the years 1965 to 1976 are adjusted for (a) population differences and (b) inflation, the correlation coefficients between values of capital commitment (adjusted for all years) and those of issues of books per capita (for each of the years) never fall below 0.554, a coefficient higher than that between issues of books per capita and the revenue expenditure on either (a) premises per 1,000 or (b) employees per 1,000 of population; but lower than those between issues of books per capita and (a) bookstock; (b) quantity purchases of books; or (c) expenditure of books per capita. It must be stressed that the high correlation coefficients are obtainable only if the values of issues of books per capita for each of the years for the 32 London boroughs are correlated with the average capital expenditure for the 12 years for each of the boroughs. Capital expenditure is episodic by its very nature, and no correlation exists between any 32 pairs of values of both variables for any one year. Because capital expenditure has to be considered as an aggregate for a period of years, or as an average for a given year, adjusted for inflation or population differences, this particular coefficient could be interpreted as meaning, not necessarily that capital expenditure has an effect on issues, but that the issue statistics have an effect on the determination of the location of capital expenditure projects. We saw earlier, that membership statistics can be used by library committees as a means of (82) determining the location of new branch libraries. If so, it is equally conceivable that issue statistics may highlight the need for capital development in an area, and thus determine capital expenditure rather than be determined by it. Even the lagged correlation of capital expenditure with the issue statistic does not provide a suitable solution to the problem, for the number of capital projects in equally sized authority areas is insufficiently large for statistical testing from one year to another. Further, as we shall show in future chapters neither the variables 'capital expenditure per capita' nor 'issues per capita' are distributed with a normal distribution. Both variables have positively asymmetric (skewed) frequency distributions. These discoveries, and the problems that they pose, are discussed specifically in the next few chapters, that is, issues per capita in chapter 3, capital expenditure in chapter 4 and the correlation between them in chapter 5.

2.7. Summary and Conclusions

These are provided in Chapter 10, Section 10.2., conclusions 15 to 28.

Table 12. Statistics of Issues per Capita, showing an apparent Curvilinear Trend, explainable by least squares (logarithmic) analysis, illustrated by the diagram underneath. (Table 13 corrects this position)

Year	Issues per Capita	Year	Issues per Capita
1880	0.23	1930	3.48
1890	0.43	1940	5.69
1900	0.75	1950	6.14
1910	1.22	1960	8.83
1920	1.91	1970	11.50



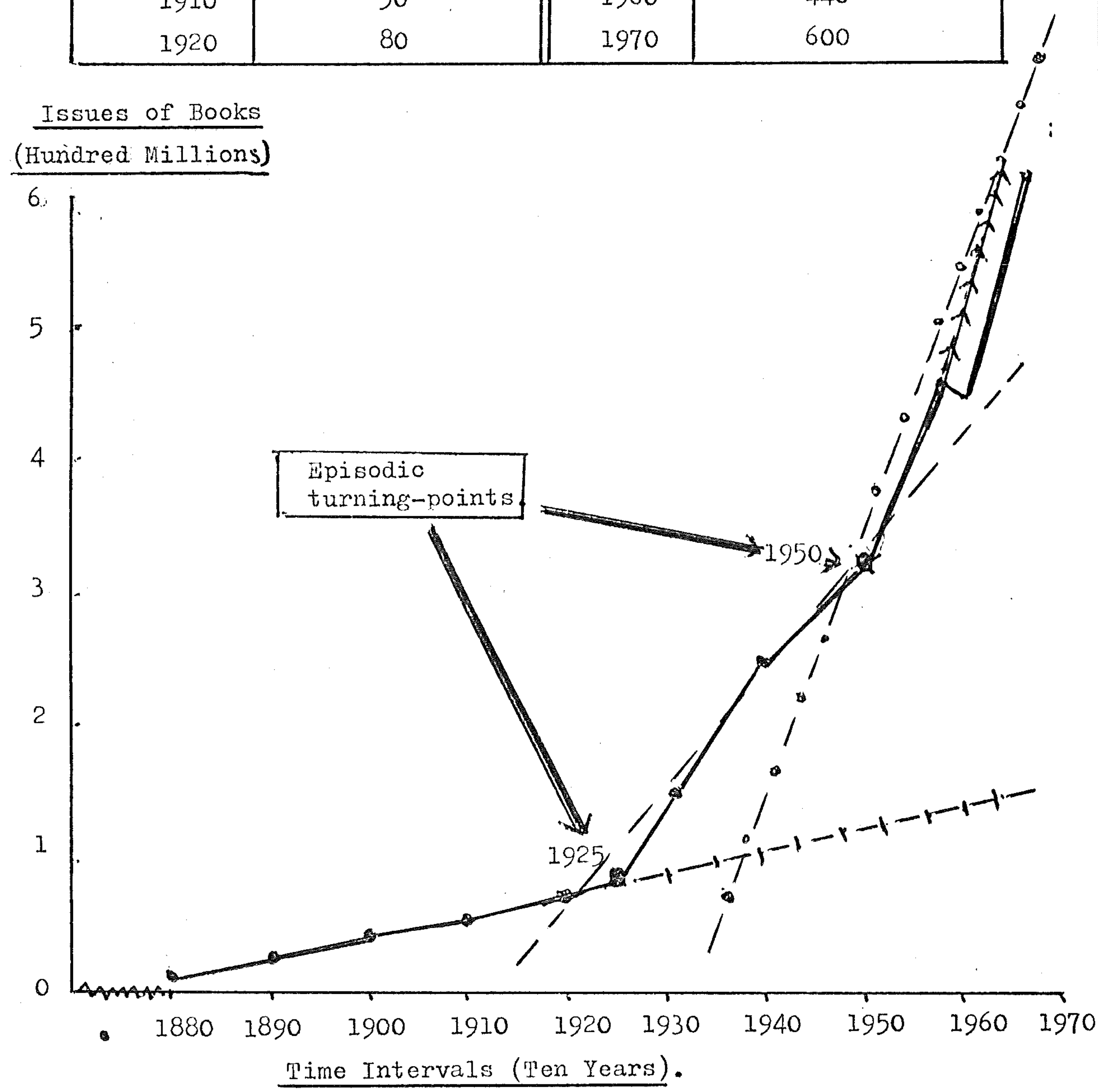
Notes

1. The apparent trend is curvilinear, the only exception being that between 1940 and 1950, which can be explained in terms of the effects of World War II. However, it consists of a composite of two variables (i) the absolute growth of issues from lending libraries, and (ii) population growth. When these variables are separated, the trend is seen to be the composite of three linear trends, with episodic turning points at 1925 and 1950.

2. The sources of this information are composite, the former being extracted from Kelly (88) and other Library Association publications, while the latter data were obtained from relevant Annual Abstracts and the Municipal Yearbook.

Table 13. Statistics of Issues as absolute values, showing the composite of three linear trend lines with turning points at 1925 and 1950 respectively

Year	Issues (approx) million	Year	Issues (approx) million
1880	7	1930	150
1890	14	1940	260
1900	28	1950	310
1910	50	1960	440
1920	80	1970	600



Key

The Actual Trend Line

The Trend line adjusted for the exclusion of educational (school) issues from some authorities' statistics after 1960.

The regression line $Y = 7 + 1.84t$ (t = years from 1880)
The regression line $Y = 90 + 8.68t$ (t = years from 1925)
The regression line $Y = 307 + 20t$ (t = years from 1950).
Y = issues of books (in millions).

Table 14. Correlation Coefficients between Revenue Expenditure and Issues of Books with Partial Coefficients controlling for population sizes using samples taken from 1971/72 pre-redistribution data

Sample Description	Sample Size	Correlation Coefficients			
		r_A	r_B	r_C	r_D
Counties of England and Wales	58	.972	.979	.981	.30
Counties, County - Boroughs & London Boroughs	171	.886	.871	.953	.38
Counties & County Boroughs	139	.947	.950	.957	.42
All English & Welsh Authorities	351	.921	.913	.966	.37
Typical London Data for Whole Period	32	.610	.373	.731	.53

Key to Correlation Coefficients

r_A. The Correlation Coefficient between expenditure and issues as absolute values (i.e. uncontrolled for population size).

r_B. The Correlation Coefficient between expenditure and size of population

r_C The Correlation Coefficient between population and issues of books (as absolute values)

r_D. The Partial Correlation Coefficient between revenue expenditure and issues of books controlling for joint correlation with size of population, using the formula:

$$r_D = \frac{r_A - r_B r_C}{\sqrt{\left[(1-r_B^2) \cdot (1-r_C^2)\right]}}$$

The least important partial coefficients are significant (90a).

Note

Although some of the above coefficients, when controlled for population, are still significant at the 1% level, it is seen that they are low for the larger authorities, and can be explained by other factors in the case of London. (see 90a supra).

Table 15 Data Relevant to the Study of Similarly-Sized Boroughs-sample prior to the 1972 Act (see 2.5(iii) for details)

(a) Means

Variable	1968/69	1969/70	1970/71	1971/72
Population	43883.57	44484.00	44050.00	44556.17
Expenditure	35573.07	41011.53	44839.00	55865.52
Book Purchases	8944.71	10327.00	9356.71	10413.47
Percentage of Rate-Fund devoted to Libraries	4.80	5.24	2.21	2.49
Issues	560737.10	564731.20	582517.70	595682.30

(b) Standard Deviations

Variable	1968/69	1969/70	1970/71	1971/72
Population	2164.56	3184.47	2622.23	3118.12
Expenditure	9877.67	12273.41	11785.48	14971.49
Book Purchases	1931.22	2784.31	1633.39	2711.88
Percentage of Rate-Fund on Libraries	1.43	1.70	0.75	1.08
Issues	138287.30	133446.40	126030.40	138699.50

(c) Relevant Correlation Coefficients

Details	1968/69	1969/70	1970/71	1971/72
Between Revenue Expenditure and Issues	0.557	0.376	0.083	0.068
Between Revenue Expenditure and Book Purchases	0.052	0.195	0.381	0.459
Between Issues and Books Purchased	0.409	0.310	0.402	0.623
Between Revenue Expenditure and Ratefund percentage	0.463	0.174	0.289	0.291

Notes

1. It was not possible to obtain reliable comparative data for the period after the passing of the 1972 Local Government Act because these authorities were merged with county authorities.
2. The standard deviations show that most coefficients of variation are low.
3. The table confirms that of Table 14, that the real correlation between revenue expenditure and issues is low, and where apparent is heavily dependent on that between revenue expenditure on books and issues.

Chapter Three - An Examination of the Frequency Distribution of the Variable, Issues per Capita

3.1. Introduction

The first part of the thesis was concerned with testing the proposition that the issues of books from libraries are the best estimator of the social income derived from the public libraries administered by a library authority, despite the fact that lending is only one of the activities of the library service. The evidence for this proposition was supplied from both primary and published data, and the method of argument in defence of the proposition was that of showing that (i) lending satisfies the greatest number of library objectives; (ii) issues have a high correlation with all other library activities; and (iii) lending is the largest of all library activities in terms of cost, usage and employment of resources. There was shown to be a prima facie case for the 'translation' of library issue statistics into social income equivalents by means of a conversion factor.

The second chapter commenced the second part of the thesis. In common accounting terms, income flows from the investment of capital. Can it be shown that issue statistics (the estimator of library social income) also flow from the investment of capital? It would not have been appropriate to assert that this is the case, without first examining the variability of the issue statistic and the factors that are known to affect it. Thus, we commenced by adopting a 'tabula rasa' approach and noting all factors that are likely to affect the issue statistic, and then proceeded to test whether they were sufficiently significant regressors for the purpose of model-building, and to eliminate them if they were not. Most of the factors mentioned in librarians' reports and in library literature were considered to be either (a) local and specific; or (b) related to indigenous, educational and social characteristics of the population of a given region. The history of the statistic appeared to show that, although educational development and the increased availability of books have 'revenue' effects on the issue statistics, in producing upward trend-lines for both (a) issues as a series of absolute frequencies and (b) issues per head of population, yet the trend-line underwent episodic changes in 1925 and 1950, that could be explained only by reference to the lagged effect of capital projects during immediately preceding years in either case. We subsequently tested the effect of revenue expenditure on the issue statistic by four different series of research tests and concluded that revenue expenditure did not significantly affect the issue statistic except in respect of revenue expenditure on the purchase of books.

In the previous chapter the 32 London boroughs were used for the purpose of tests, because they seemed to provide some proof of the alternative hypothesis, that issues are responsive to revenue expenditure. A sample of smaller town boroughs in England and Wales (as they existed prior to the 1972 Act) was also used for this purpose. Now that it has been shown, particularly in the case of London, that, even in such cases, issues respond to capital rather than to revenue expenditure we are in a position to return to a more general study of the data for England and Wales to see whether, for a much larger sample over a period of years, capital expenditure has a lagged effect on the issue statistic.

The counties of England and Wales vary considerably in size - from small counties, such as Rutland and the Isle of Wight to large counties such as Lancashire and West Yorkshire. Because of the effect of the redistribution of library authorities, it is now impossible to correlate the absolute frequencies of issues with absolute amounts of capital expenditure, or even increments of issues with capital expenditure, lagged by several years, for this poses the obvious problem of autocorrelation (of time data of population size with itself). The obvious solution would be to correlate capital expenditure per head of population with increments in issues per head of population, tracing the effect of one on the other over a period of years. But though the use of 'per capita' conversion of the two variables eliminates the effect of different population sizes, it may generate other problems. For example, in large authorities the effect of intra-regional differences in the per-capita issue statistic is lost, and the values of this variable will be bunched near to central measures of location, while the dispersion of the values of the variable for the smaller library authorities will be greater. I shall show later in the chapter that the effect of the reduction of library authorities resulting from the 1972 Act was to produce greater bunching of the issue statistic near the 'mode' of between 11 and 12 issues per head of population. A further problem that results from the expression of issue statistic in terms of the population unit is that greater weight is given to smaller counties. The variable 'issues per head of population' is, in some respects, no more than a heuristic management ratio. I shall show in the chapter on the frequency distribution of capital expenditure per head of population, that such heuristic ratios can generate even larger problems, as for example, better correlation with area than with population, and the fact that equal amounts of capital expenditure have much larger effects on the ratio for counties with small populations than they do on the ratio for larger counties.

But, because we cannot obtain a statistically valid sample of comparably sized counties, particularly in the terminal years of our study, it is necessary to recognise these limitations in the use of this variable and proceed to examine its characteristics.

First we shall proceed to select a statistically useful sample, and state why it has been selected in preference to other samples that may have been chosen for statistical analysis. This involves considering (i) the choice of region for the purpose of study and (ii) the terminus a quo and terminus ad quem in which the effect of capital expenditure per capita on increments in issues per capita may best be studied.

Secondly, having chosen the sample, it will not be possible to examine the correlation coefficients of increments of capital expenditure per capita with increments of issues per capita without first examining carefully the frequency distributions of both these variables, since, if the frequency distributions were both highly positively asymmetric (skewed) the correlation coefficient between them may be adversely affected by a few very high values, and then there would be a case for assuming that some non-parametric tests would be almost as powerful as those that involve the normal distribution. The frequency distribution of the variable, issues per capita, will be studied in this chapter, and that of the variable, capital expenditure per capita, will be studied in the next chapter.

Thirdly, we shall not be in a position to examine the effect of capital expenditure, on the issue statistic without first examining changes in the frequency distribution of the variable, issues per capita, between the two terminal points of our study. This involves asking two basic questions (i) To what extent has the dispersion of the variable changed between the two terminal points? and (ii) To what extent have the measures of central location of the variable changed between the two terminal points?

Finally, the chapter contains the results of a non-parametric 'median' test on the data to assess the significance of the change in the issue statistic between the two terminal points. It will be against the background of a small change in the variable, issues per capita, that we shall, in later chapters calculate index changes for each county, using two commencing and two terminal years for the purpose of examining lagged effects. This chapter has thus four sections:

(i) an analysis of reasons for the selection of the sample;

(ii) an examination of the frequency distribution of the variable, issues per capita in the commencing years of the period;

(iii) an examination of the frequency distribution of the variable in the concluding years of the period; and

(iv) an assessment of the significance of changes in the variable during the period.

3.2. The choice of sample for the purpose of research

For the purpose of obtaining statistical validity it was desirable, at the outset, to cast the net as wide as possible, and to use the English and Welsh counties to assess the characteristics of the frequency distribution of the variable, issues per capita. Because of problems posed by the capital expenditure variable, the Welsh counties were later excluded, but the study of English counties involves retrospective study of those library authorities that were included in the English counties after the redistribution of the 1972 Act, and it is therefore desirable that the study should include all English and Welsh authorities, at this stage, for the purpose of assessing the characteristics of the frequency distribution. The refining of the sample from the original set of data for 360 library authorities to the specific set of new English counties is a necessary consequence of the fact that the largest English sample since the redistribution may be obtained from the new English counties. For the purpose of studying the issue statistic the number of observations (number of variate values obtainable) was kept as large as possible, for the purpose of statistical validity.

Yet it may be questioned why Scottish and Northern Irish library authorities were not included in the sample. This is because, subsequent to the passing of the Local Government Act of 1972 the administrative structure in Scotland became entirely different, following the recommendations of the Wheatley Commission (1969), and the authority of libraries passed from counties (29), cities (4) and boroughs (39) to regions (3), districts (31) and separate authorities of Orkney and Shetland (2), and as the study included correlation with capital expenditure, the effect of reallocation of pre-redistribution statistics for the comparison would have been to reduce the power of the test, and so offset any additional power that may have resulted from the inclusion of the Scottish authorities in the sample. Northern Ireland was also differently reorganised, subsequent to the report of the Macrory Commission, and the effect of this reorganisation combined with that of the smallness of additional sample size would have produced a net reduction in the usefulness of the research and affected its validity.

It was decided to use the years 1969/70 and 1970/71 as the two termini a quo for the study. Two years were chosen (i) for the purpose of examining lagged effects when later correlating this variable with capital expenditure; and (ii) in order to obviate the likelihood of stochastic and episodic effects in the data for any one year. The examination of <u>two</u> years' data instead of <u>one</u> gives a better overall view of the variable at the beginning of the period. The actual choice of the years themselves was a result of the tentative hypothesis suggested in the previous chapter, that there is an approximate lag of about four years between the initial investment of capital and the resulting increment in the issues of books. Since the data for the study required to be as recent as possible, and since the most recent statistics available during the period of research were in respect of 1974/75 and 1975/76, it was most appropriate to use these two years as the 'termini ad quem' for the study of the sample. A lag of four years would require that the latest year that could therefore be used as the 'terminus a quo' would be 1970/71, and as, for both commencing and concluding termini, it was preferable to use two years, to obviate the effects of stochastic and episodic disturbances, the most appropriate years for 'termini a quo' were therefore 1969/70 and 1970/71, and for 'termini ad quem' 1974/75 and 1975/76. The strategy will be to use as large a sample of authorities as possible for studying the frequency distribution of the issue statistic, but to confine the sample to cases where correct statistical study can be made, for the purpose of correlation with capital expenditure. In this chapter, therefore, where we shall be confined to studying the issue statistic, all available data for England and Wales will be used.

We are now in a position to ask two important questions: (i) whether there was a recognisable change in the frequency distribution of the variable, issues of books per capita, during the period from 1969 to 1976; and (ii) whether there was a significant change (i.e. increase or decrease) in the central location of the statistic. (90b)

There are four complicating factors, that must be taken into account:

(90b). The term 'central location' is here used to mean any appropriate measure of central tendency or 'average' in the statistical sense. The <u>most</u> appropriate measures are discussed later.

(i). The effect of the 1972 Act was to reduce the number of library authorities, and thus, because of amalgamations, to reduce the number of extreme values, and increase the number of modal or central values of the variable for the two terminal years. Thus the two terminal frequency distributions have more of a leptokurtic appearance, than would have (90c) been the case if statistics had been available for all areas comparable with the sample of nearly 360 library authorities used for the frequency distributions of the two commencing years.

(ii). The values of the variable were taken from areas of unequal size. As suggested in 3.1. a limitation imposed by the simple use of the variable 'issues per capita', is that values may differ for areas of large population, as distinct from areas of small population. It was suggested in chapter 2 that there is an optimum population for issues of books from libraries, but that this is not a function of size, but of other factors. This question is, in some measure, different. It is whether there is significant difference in the variable, issues per capita, between large and small authorities. It is obvious from (i) that the use of large authorities tends to obscure and reduce the extreme values of the variable, because such authorities' statistics tend to 'average' high and low extreme values, but apart from this obvious limitation, a study of the two samples of 360 values for the years 1969/70 and 1970/71 showed that the difference in the mean values of issues per capita for stratified samples of large, small and medium-sized authorities were not statistically significant at either the 5% or the 1% levels of significance.

(iii). During the years of transition to comply with the new legislation of the 1972 Act, the issues

(90c). This is more apparent than real. In true leptokurtosis there is greater 'peakedness' in the distribution curve, even though ranges and standard deviations are comparable. In this case standard deviation is less.

of books from the new library authorities were not available for publication in the Municipal Yearbook and were not obtainable, except by writing directly to the new authorities themselves. This was more particularly true for 1973/74, than for 1974/75, and statistics for the earlier year would not have been reliable. In the case of 1974/75 it was possible to remedy deficiencies of published statistics by correspondence, but this problem explains why it was not meaningful to use intermediate years in the period.

(iv) The final complicating factor is the lack of uniformity of the statistics, and the complete absence of a number of others. For example, for 1969/70 the Municipal Yearbook issues frequency of 4040634 for the London Borough of Camden appears high relative to Camden's population such as to give the value of issues per capita of over 17 books per capita. When attempting to verify this statistic from Camden's own library reports, I discovered that Camden (uniquely among London boroughs) included record issues (516746) in the aggregate, and that the adjusted value of issues per capita was only 15 in the case of Camden. In other cases, the Municipal Yearbook issue frequencies did not concur with abstracts published by the library authorities themselves. For one example out of many, in the case of Waltham Forest, the 1969/70 aggregate issue statistic (2981426) in the Municipal Yearbook concurred with the authority's own abstracts of statistics, but there were not only errors in the values carried forward from previous years, but also evidences of transposition errors in addition, because of differences between the Municipal Yearbook aggregate issue frequency and the aggregate of the classified (i.e. adult, junior, schools, institutions etc.) issue frequencies appearing in another publication, The Libraries, Museums and Art Galleries Yearbook, published for that year. Thus, there was evidence of small inaccuracy, not only in secondary data, but also in the primary sources from which the published data were taken. Lack of uniformity, absence of standardization, primary data errors and errors of omission are all important, for these complicating factors illustrate that the Municipal Yearbook statistics required confirmation wherever possible.

We have thus shown why the counties of England and Wales, together with all smaller authorities, were chosen for the purpose of analysis, and why the time period chosen spanned the years 1969/70 to 1975/76, why two pairs of years were used respectively for commencing and concluding termini, and have briefly discussed the limitations of the study, the problems posed by Local Government redistribution; by the use of differently sized authorities; by the unavailability of published data and by lack of uniformity, standard -ization, primary data errors and errors of omission in primary data. Most of these problems do not affect the study significantly, but we shall show that the reduction of the number of library authorities may have affected the shape of the frequency distribution.

3.3 Issues per Capita during the two Termini a Quo

Having shown the frequency distributions that can be constructed from issues per capita for the period under discussion, let us now examine them for the two 'typical' years at the commencement of our period. They are derived from values of the variable for 360 authorities (i.e. counties, London boroughs, county boroughs, other boroughs and urban districts that existed prior to the redistribution effected by the Local Government Act of 1972). In order that the frequency distribution may be compared meaningfully with those for the years 1974/75 and 1975/76, when there were fewer library authorities it was desirable to express the distribution in terms of relative, rather than absolute, frequencies. Table 16 therefore shows in columns, (i) the relative frequency distribution for 1969/70; (ii) the relative frequency distribution for 1970/71 and (iii) that for 1969/70 and 1970/71 combined. There is another important reason for the translation of frequencies from absolute to relative values. It is that such transposition will assist us to decide the best formula of model apposite to the frequency distribution.

It can be seen from the table that although it is possible to discern a small movement away from extreme values when comparing the two years' frequency distributions, the actual difference is not significant. Thus, although it is conceivable that some library investment in the intervening (or in earlier) year(s) helped reduce the frequency of authorities with low values of issues of books per capita, it is impossible, from this evidence alone, to reject the hypothesis that there is no significant difference between the frequency distributions for the two years.

However, an examination of the table shows that the frequency distributions are not normal but are positively skewed. The kind of positive skewness is both peculiar and interesting, yet it appears to have escaped the notice of writers and researchers on the 'library' aspects of this topic, who have, for the most part, written about aggregate and mean, absolute and per-capita values of the variable.

The frequency distribution is peculiar because, although one could not expect it to be Gaussian (for there is no possibility of negative values of this variable) yet it does not range between zero and a given 'maximum' as would be the case for most binomial and Poisson frequency distributions.* The distribution is a composite. It consists of a composite and a 'Poisson' component.

The reason for this composition is clear. Very few library authorities have values that fall below 7 per capita per annum, and none have values lower than 4. The inference is that there is a minimum number of books issued per capita per annum, and that this minimum can be assumed regardless of the variability of capital investment or of any other controllable regressor. It is probable that this minimum reflects the existence of an enthusiastic 'hardcore' of those who will be library members and borrow a minimum of between 20 and 30 books per annum, regardless of library investment.

The use of a computer programme to fit the data to that of a frequency distribution of a variate (i.e. random variable) rather than that of an exogenously determined variable, gives the best approximation to the frequency distribution as

$$dF_{\lambda}\, x = k + (e^{-\lambda}\lambda^{r})/r! \; ; \; k \leqslant x \leqslant \infty$$

where

(i) k is the constant 'minimum' number of issues of books per capita per annum of the authorities;

(ii) e is the exponent, (i.e. approximately 2.718);

(iii) λ is the mode difference between variate values and k, so that k + λ is the mode of issues per capita per annum; and

(iv) r is the class interval.

For the composite frequency distribution for 1969/70 and 1970/71 the values of k and λ are respectively 4.2 and 6.8, so that the formula becomes:

$$dF_{\lambda}\, x = 4.2 + (2.718^{-6.8}\, 6.8^{r})/r! ; \; 4.2 \leqslant x \leqslant \infty$$

for the two years concerned.

It must be stressed that this adaptation of the Poisson formula differs from it, not only in form but in usage. The Poisson distribution is most often associated with discrete occurrences. This use of the composite formula (a constant plus a Poisson variate) is associated with continuous (i.e. interval class) occurrences. Although interval classes of 2 books per head of population per year (e.g. 7 and under 9) were used for convenience in Table 16, Table 17 shows that, for example, for the year 1969/70 the formula closely approximates the frequency distribution where class intervals are 1 per head of population.

Thus, although the fact has escaped the notice of writers on library science, the resemblance between the frequency distribution of issues per capita per annum and a composite of k and the Poisson distribution of r, where λ-k is the mode frequency, is an important resemblance even when using the statistics of only one year. Differences between the frequency distributions for the two years 1969/70 and 1970/71 can be explained partly by random differences and partly by the assumption of the nearest integer for comparative purposes. The important feature of the study is that the distribution is not simple Poisson, but that there is a minimum number of books per annum per head of population, (k), below which the values of the variable do not fall.
The shape of the distribution is not affected by the fact that, in this case, it was compiled from the statistics of all library authorities, of unequal population sizes. The fact that there was, before the 1972 Act, a large number of small library authorities is statistically useful, because dissimilarities between intra-authorities' sub-regional areas are not obscured so easily by the use of single values for whole authorities, as they are in the case of larger authorities. To illustrate this

fact I have prepared Table 18, which shows both the absolute and relative frequencies for the 56 smaller pre-redistribution English and Welsh counties for 1970/71. I stated in 3.2 that there was no significant difference in the shape of the frequency distribution, despite the obviously smaller range for large authorities because of the elimination of intra-regional differences. It can now be seen that this is the case. Table 18 (for counties) was also prepared, because in the following chapters we shall be using the English counties largely, and it is therefore necessary, at this stage, to be sure that, given the above limitation, the mean and dispersion are not significantly different for small authorities than they are for large, or for all authorities.

Thus, the apparently leptokurtic appearance of the frequency distribution of Table 18 does not result from the contraction of the range of the variable, for this is similar to that for all authorities. In 1969/70, for example, it varied from 7 to 21 issues per capita, Hertfordshire and Flintshire having these very high (90d) values (≑ 21). The fact that for counties there is a greater bunching around central location will assist us to make comparisons with the frequency distribution of values of the variable, for post-redistribution counties.

3.4. Issues per Capita during the Termini ad Quem.

Because larger authorities were created by the 1972 Act, the frequencies of values of issues per capita per annum suffer from bunching, similar to that for the smaller pre-redistribution counties displayed in Table 18. The sample is thus much smaller than that for the 360 authorities that existed prior to the Act, and in order that the frequency distributions for both years may be fully appreciated, because of the smallness in sample size of the three types of library authority, county, London and 'district' it was necessary to study absolute frequencies before making generalizations about relative frequencies, and to use interval classes of 1 issue per head of population. In this way, the greatest possible accuracy was obtainable from the much smaller sample size. Thus, Table 19 shows the analysed frequency distributions for each of the three categories of library authority and their marginal categories of distribution for each of the two years 1974/75 and 1975/76, and for the two years combined.

The analysis of the distributions for each of the two years does not give the same approximation to the distributions for 1969/70 and 1970/71 (i.e. a constant and a Poisson component), for in the case of 1974/75 there is bimodality (because of the small 'hump' in the interval category '9 and under 10 issues per head') though the actual mode of the distribution is in the class '11 and under 12 issues per head'. In the case of 1975/76 there is nearer proximation to the model that has already been outlined in 3.3, except that the range of metropolitan district values of the variate is smaller, probably because of the elimination of intra-authority variation. The mode has certainly increased, and we shall later question whether the increase is significant. In the 1974/75 case $k + \lambda = 12$, and in the 1975/76 case the 'mode' (i.e. $k + \lambda$) falls between 12 and 13. It may be thought that the increase between the two terminal years 1974/75 and 1975/76 is a significant one, particularly as the time series study of chapter 2 indicated an upward direction in the values of the variable, for not only are the modes different, but the median value of the variable for 1975/76 is also higher than that for 1974/75. The simplest test that can be applied to discover whether the years' values of the variable are significantly different is the median test. This involves (i) obtaining the joint median for all values of the variable for the two years,

(90d). Some of these very high values of issues of books per capita ($x > 21$) result partly from the inclusion of schools issues in the aggregate population statistics, but this does not significantly affect the shape of the frequency curve.

grouping the frequencies of values in each year that fall higher or lower than the group median. If, using a 2 x 2 contingency set of four frequencies, the frequencies in 1975/76 are, with Yates correction of the chi-squared statistic significantly different from those in 1974/75 we may assume significant difference, and therefore question compatibility of the years as a joint 'terminus ad quem' for our study. If the null hypothesis is maintained, then we can assume that the increase in issues per capita follows the slow upward trend described in chapter 2, and that each of the two years needs not to be considered in isolation.

In fact, the median of the 225 available values of the variable (113 for 1974/75, but 112 for 1975/76) is 11.64, and in 1974/75 61 of the values fell below 11.64 and 51 of the values above it, while in 1975/76 51 of the values fell below 11.64 and 61 above it. Using Yates correction, the chi-squared statistic for the 2x2 contingency set is:

$$\frac{(4.5)^2}{61} + \frac{(4.5)^2}{51} + \frac{(4.5)^2}{61} + \frac{(4.5)^2}{51} = 1.45$$

Even at the 10% level of significance it is necessary that the chi-squared statistic should exceed the critical value of 2.71 to indicate a significant difference. We can therefore, despite apparent differences, combine to values of the variable for the two years to indicate the terminus ad quem position. Further, at this stage, we wish to compare the frequency distribution with the joint frequency distribution for the two years 1969/70 and 1970/71 and therefore require tables comparable to Table 16 despite differences of sample size. Table 20 attempts such a comparison, and attempts to provide the nearest Poisson frequency distribution, where $k = 6$, $\lambda = 6$ and the mode of the distribution $(k + \lambda) = 12$.

It is seen from the table (20) that there is now considerable peakedness (or bunching) in the category '11 and under 13 issues per annum', and this must cause some concern, for although there is now some approximation to the distribution with the formula:

$$dF,\ x = 6 + (2.718^{-6}\ 6^{r})/r!\ ; \qquad 6 \leqslant x \leqslant \infty$$

there is greater bunching at the central location.

This bunching is only partly explained by the transition to a smaller number of larger library authorities (i.e. from 360 to 113 observations) for our study of 56 counties in 3.3 indicated that, even for 56 observations of counties only in 1970/71 it is possible to have values ranging from 7 to 21 issues per capita per annum.

The most important contrast between the two pairs of years is that k (the typical minimum value of the variable) increased from 4.2 to 6.0. This cannot be explained merely by saying that the 1974/75 and 1975/76 frequency distributions are compiled from larger authorities and that intra-regional extremes have therefore been obscured by the use of the means of larger populations. Somehow, the library authorities with the poorest results became better during the period. We shall examine this difference more closely in the next section.

3.5. Changes in the Variable during the period 1969-1976

There does not appear, prima facie, to be a significant difference between the mode of 11 issues per capita in 1969/70 and 1970/71, and that of over 12 issues per capita in 1974/75 and 1975/76. The use of two-year variable values in both cases has eliminated the possible effect of random and episodic disturbances, and there are no obvious cyclical effects nor seasonal factors. The use of non-parametric median and modal tests using 2 x 2 category tables, similar to that described in 3.4, did not indicate significant differences in medians or modes for any of the 9 possible pairs of years in the set 1969/70, 1970/71, 1974/75 and 1975/76. But although the modes and medians of the distributions did not change significantly over the period, it has already been suggested that there was a significant change in the 'shape' of the frequency distribution because of the increase in the value of k from 4.2 to 6.0, and the corresponding decrease in the value of λ, indicating a probable improvement in the performance of the 'poorest' performers.

This is not intuitive. It may be tested by using a four-category chi-squared test of the frequencies '8 issues per capita and under' and 'over 8 issues per capita' for the two years 1969/70 and 1975/76, where the null hypothesis of no significant change can be rejected, but only at the 10% level, where the chi-squared statistic is 2.71.

I have avoided the use of the mean of the variable because it has already been shown that the distributions are positively asymmetric for all years studied and that the mean values are therefore not as useful as they would have been if the distributions were Normal. I shall show that there is a significant increase in the mean, but before doing so it is useful to discuss the mean generally in terms of stratified data . For most of the years between 1969/70 and 1975/76 the mean values of the variable for all stratified data (e.g. counties, London boroughs etc.) vary between 10 and 12 issues per capita. If one, for example, takes the middle year of the period (i.e. 1971/72) the mean values of the variable were respectively 11.343 for the 56 pre-redistribution counties; 10.95 for counties and county boroughs; 11.13 for the combined class of 171 counties, county boroughs and London boroughs, and 11.935 for the 32 London boroughs taken per se. This is the most satisfactory 'mid-point' to use for the examination of data immediately prior to the 1972 Act, for there were, as I stated in 3.2, several omissions in subsequent statistics because of the effect of reorganization. For this particular year, the mean rate of issues of books per capita for the 351 reported authorities calculated on a population basis to the nearest thousand was, using the symbol K to indicate 1,000.

$$\frac{563,214K}{49,330K} = 11.41.$$

Thus the mean value for the whole reported population is somewhere between the values of 11 issues per capita for 1969/70 and 1970/71 and that of 11.95 issues per capita for 1975/76, the final year of the period. In this case there are only three strata-categories, so that analysis is easier. For 1975/76, the values of the means of the variable, issues per capita are respectively:

(i) for counties, $\frac{361,444K}{29,396K} = 12.29$;

(ii) for London boroughs, $\frac{82,378K}{7,019K} = 11.73$;

(iii) for metropolitan districts, $\frac{126,661K}{11,319K} = 11.19$; and

(iv) for all reported values in England and Wales,

$$\frac{570,483K}{47,734K} = 11.95$$

These means and those of other years are calculated from aggregate population statistics, and are therefore not identical with the means of the frequency distributions themselves,

It is against the background of the non-parametric tests and the asymmetry of the frequency distributions that we must attempt to assess changes in the mean value of the variable from one year to another. If the limitations are ignored, the standard error of the difference between means, for example, between 1971/72 and 1975/76 is:

$$\sqrt{\frac{2.4^2}{351} + \frac{1.7^2}{112}} = 0.2$$

and the increase, for example, of 0.75 between 1971/72 and 1975/76 is significant at the 5% level using either a one-tail test for increase, or a two-tail test for difference. But this approach to the problem, that of using the post-redistribution standard deviation of 1.7 to estimate the standard error, overlooks the fact that intra-regional dispersional differences in values of the variable are obscured by using the statistics of the larger library authoritie . It is best to use $\sigma = 2.4$ for the calculation of standard error. If this revision is implemented, and a two-tailed test is used for absolute difference (i.e. positive or negative) between the two means, the rise in the statistic can be said to be significant at the 5% but not at the 1% level. If the revision is not made, or if a one-tailed test is implemented, the increase is significant at both the 5% and the 1% levels. The asymmetric nature of the frequency distributions for all years indicates that we should be cautious, not only in accepting the significance of the increase of the mean, but also in determining the critical levels of significance for the variable. If the distribution were symmetric we should regard values as significantly high or low at P = 5% where they were <u>outside</u> the range $\pm 1.96\sigma$, (i.e. between 8.6 and 15.4) and at P = 1% where they were <u>outside</u> the range $\pm 2.58\sigma$, (i.e. between 7 and 17). Because of the asymmetric nature of the frequency distribution it is best to regard cases below 8 and above 16 issues per capita as significant at P = 5% and those below 7 and above 18 issues per capita as significant where P = 1%. Such cases may need particular attention to determine whether or not they have been affected by capital expenditure.

A further limitation in assessing significance is the inclusion or exclusion of issues to schools, particularly by county councils. This factor can cause a variation of between 0.5 and 5 issues per capita, and may be included one year, excluded the following year, and sometimes later reincluded in, for example, Municipal Yearbook statistics. However, cases of a difference of 5 issues per capita (e.g. Hertfordshire during the early 70's) are not too common, reporting is mostly consistent and the frequency distribution is not affected.

<u>3.6. Summary</u> This is provided in 10.2. Conclusions 29 to 33.

Table 16. Relative Frequencies of Issues per Head of Population for Library Authorities 1969/70-1970/71

Class Interval	Relative Frequency - Library Authorities		
	1969/70	1970/71	Both Years
Under 7	0.03	0.01	0.02
7 and under 9	0.09	0.08	0.08
9 and under 11	0.24	0.27	0.26
11 and under 13	0.26	0.28	0.27
13 and under 15	0.19	0.18	0.19
15 and under 17	0.12	0.12	0.12
17 and under 19	0.04	0.04	0.04
19 and over	0.03	0.02	0.02
Total	1.00	1.00	1.00

Note

The above table was compiled using the 360 pre-redistribution library authorities of England and Wales. The problem of differences in population sizes is discussed in the text.

Table 17. Relative Frequencies of Issues per Head of Population 1969/70, showing nearness to predicted values (k + Poisson distribution), where k = 4.2

Class Interval Lower Integer	Frequency	Relative Frequency	Nearest (r) integer where k = 4.2	Expected Poisson Relative Frequency
5	3	0.01	0	0.0011
6	5	0.02	1	0.0076
7	13	0.04	2	0.0257
8	17	0.05	3	0.0584
9	45	0.12	4	0.0992
10	41	0.12	5	0.1350
11	54	0.15	6	0.1529
12	41	0.11	7	0.1486
13	36	0.10	8	0.1263
14	32	0.09	9	0.0954
15	29	0.08	10	0.0649
16	16	0.04	11	0.0401
17	7	0.02	12	0.0227
18	10	0.02	13	0.0119
19	5	0.01	14	0.0058
20	2	0.01	15	0.0026
21	2	0.01	16	0.0011
22	1	0.00	17	0.0004
23	1	0.00	18	0.0003
	360	1.00		1.0000

Note

For calculating 'Poisson' frequencies $\lambda = 6.8$, $k = 4.2$

Table 18. Typical Frequency Distribution of the Variable, Issues per Capita per Annum for the 56 Counties 1970/71

Class Interval	Frequency	Relative Frequency
Under 9	5	0.09
9 and under 11	23	0.41
11 and under 13	20	0.36
13 and under 15	6	0.11
Over 15	2	0.03
Total	56	1.00

Note

This table has been provided because it gives a better means of comparison with the tables for the end of the period, i.e. 1974/75 and 1975/76. Note that although all the tables on this page have an appearance of leptokurtosis, actual leptokurtosis is not as great as apparent, for the variances are different (see 3.5). True leptokurtosis exists, in spite of, not because of any differences in the variance or standard deviation.

Table 19. Categorised Absolute Frequency Distributions for all English and Welsh Library Authorities 1974/75-1975/76

Class Interval	1974/75				1975/76				Total
	C	L	D	Total	C	L	D	Total	
Under 7	1		1	2					2
7 & under 8			3	3	2		1	3	6
8 " " 9	3	4	4	11	1	2	2	5	16
9 " " 10	4	7	8	19	3	5	7	15	34
10 " " 11	6	3	5	14	5	3	7	15	29
11 " " 12	10	7	4	21	6	6	8	20	41
12 " " 13	8	5	8	21	15	5	3	23	44
13 " " 14	6	3	1	10	5	5	4	14	24
14 " " 15	4	2	1	7	3	3	2	8	15
15 " " 16	1	1		2	2	2	1	5	7
16 " " 17									
17 " " 18					2			2	2
18 " " 19									
19 " " 20			1	1		1		1	2
20 " " 21	2			2					2
21 and over					1			1	1
Total	45	32	36	113	45	32	35	112	225

Key C = Counties; L = London; D = New District Councils

One 'district' value was not available for 1975/76.

Table 20. A Relative Frequency Distribution of Issues per Head of Population for Library Authorities 1974/75 and 1975/76 for comparison with Tables 16 & 17.

Class Interval	Relative Frequency – Library Authorities			
	1974/75	1975/76	Both Years	'Poisson' Approximation $k = 6$ and $\lambda = 6$
Under 7	0.02	0.00	0.01	0.0174
7 and under 9	0.12	0.07	0.10	0.1338
9 " " 11	0.30	0.27	0.28	0.2945
11 " " 13	0.37	0.38	0.38	0.2983
13 " " 15	0.15	0.20	0.17	0.1721
15 " " 17	0.02	0.04	0.03	0.0638
17 " " 19	0.00	0.02	0.01	0.0165
19 and over	0.02	0.02	0.02	0.0036
Total	1.00	1.00	1.00	1.0000

Notes

1. The relative frequencies in this table are calculated from the absolute frequencies in the totals provided in the marginal columns in Table 19.

2. The term 'Poisson' is used in this table and in Table 17 to mean that x may be approximated by using the Poisson distribution plus a constant k, as explained in the text, where x is the frequency of r, i.e. for this pair of years:

$$f(x) = 6 + (e^{-6} 6^{r})/r!$$

Because of bunching at central location (modal class = 11 and under 13), the approximation is inaccurate for that value.

Chapter Four - A Study of the Variable, Capital Input Expenditure per Capita, its distribution and characteristics

4.1. Introduction

The study of the variable, issues per capita, has shown it to be positively asymmetric in frequency distribution, and that the result of both the 1972 Act and the significant increase in the lower values of the variable was the presence of bunching at central location in the later years of our period. It was shown that there had been a significant increase in the mean value even at the 1% level if positive asymmetry is not taken into account, but that, because of positive asymmetry, the mean value can be misleading, and account should be taken (i) of modal values and (ii) of the non-parametric median test result. If the larger value of the variance is used, based on the larger sample for earlier years, and on the upper tail of the asymmetric curve, the test can be adjusted to show a change in the mean value at the 5% but not at the 1% level of significance.

These findings caution us against assuming that if the correlation coefficient between capital expenditure per capita and issues per capita (or any changes in the variable) is significant there is necessarily evidence of an effect of capital expenditure on issues, even though F-ratios proved significant, and the application of Durbin-Watson tests showed that autocorrelative effects could be eliminated. Extremely high values of the variable can affect the correlation coefficient, particularly if it can be shown that capital expenditure also has a positively asymmetric frequency distribution. There are methods of dealing with this problem. We may either (i) calculate non-linear correlation coefficients by logarithmic or other adjustment of the scales of the variables; or (ii) use the rank correlation coefficient as a less-powerful but adequate alternative, for if this were used there would be no unduly high bias for extremely high values of the variable.

Before we can decide whether the normal Pearson coefficient is adequate it is necessary to examine the frequency distribution of the variable, 'capital expenditure per capita' carefully. We must assume some positive asymmetry, for the values of the variable will, in theory range between 0 and ∞

and there would be no negative values. It has already been suggested that the 'per capita' conversion of the variable may generate problems, though such conversion is necessary to obviate the effect of partial correlation of both issues and capital expenditure with population size. It is, nonetheless, a heuristic 'management ratio' and, in the case, as I shall show, the expression of the variable in terms of 'per head of population' actually contributes forcefully to the asymmetry of the variable's frequency distribution.

Having discussed these limitations of analysis, I shall proceed in two ways. I shall show that the problem of positive asymmetry is such that it is preferable to use the counties of England and Wales for the purpose of analysis, rather than to use all library authorities (360 reducing to 113) as in the previous chapter. The counties will require to be readjusted when the effect of capital expenditure on issues is studied in the next chapter, but in this case the problem is not as large as it appears, because of capital contributions from counties for other library authorities prior to the 1972 Act. Then the sample must be reduced even further, because of the effect of extreme values in Welsh counties where population sizes are so small that a medium capital outlay for any one year appears very large when expressed as a 'per capita' value. The capital expenditure of Rutland is treated in the same way. I shall return to Rutland, and to small authorities when treating individual cases in the third part of the thesis. Having obtained a useful sample, that is, large enough to apply the normal (i.e. non-Studentised) (90e) criteria, it will be possible to ask two important questions: (i) whether the capital expenditure (per capita) on libraries bears any relationship to the aggregate capital expenditure of English counties on <u>all</u> categories of capital expenditure over the period of study; and (ii) whether there is good correlation between values of the variable for all pairs of years during the period that is being considered.

(90e). The term 'Studentised' is here used, as in Statistics, for sampling distributions less than 36 observations.

For our purpose the 'terminus ad quem' needs adjustment. It is unlikely that capital outlay in a given year 't' will affect the issue variable in year t. It is more likely that expenditure in t-1 will affect the issue statistic in t, and as we have selected the pair of years, 1974/75 and 1975/76 as the terminus ad quem for the issue statistic, we need not consider capital expenditure later than 1973/74. I shall, however, allude briefly to later values of the variable in order to give completeness to the study.

Thus this chapter contains:
(i) a study of the problems and relevance of using the 'per capita' converted values of capital expenditure for the purpose of analysis;
(ii) an examination of the composition and changes in the frequency distribution of this variable during the period from 1969/70 to 1973/74 and 1974/75;
(iii) an assessment of the extent to which capital expenditure on libraries during that period was a function of available capital expenditure for all categories in each of the years concerned; and
(iv) a study of the inter-year correlations of pairs of years during the period, with respect to values of the variable, to assess whether the English counties behaved consistently.

For the purpose of subsequent divisions of the chapter problems (ii) and (iii) are paired as it is preferable to consider inter-category correlation for each year when we consider the frequency distribution of the variable. Thus, I shall employ a separate section for each year, and deal with problem (iv) generally before summarising conclusions.

Finally, it will be evident from (i) that economies of scale must be considered when applying the 'per capita' conversion of the variable. This problem can be considered when dealing with characteristics of the variable for each year.

4.2. Problems of using 'per capita' values of capital expenditure, and their effect on our choice of sample

In chapter three I discussed some of the problems posed by the use of values expressed per head of population, when dealing with the issue statistic. In this section I discuss the problem of such conversion when dealing with the capital expenditure statistic. It is a useful device, and is employed by the Society of County Treasurers in its annual publication Capital Expenditure Statistics for eliminating the effect of population size-differences for inter-county comparisons. But the presence of this heuristic management ratio does not solve problems of comparability completely, for there is need to consider:

(i) the problem of the relevance of population size to capital expenditure; and

(ii) the question whether there is an optimal size of county, and limitations in the use of 'per capita' values of the variable for this purpose.

This thesis has to deal with 'per capita' values of the variable because such values

(i) aid comparison between large and small counties;

(ii) obviate the problem of partial correlation with population size; and

(iii) are readily available from the annual publication Capital Expenditure Statistics.

The use of Capital Expenditure Statistics poses other problems, because actual capital expenditure on libraries per unit of population is not (i) standardised nor are there (ii) subcategories showing actual per capita expenditures on (a) buildings; (b) land; (c) equipment (d) initial bookstocks and because mobile libraries are often funded from revenue. Thus, this study is only a first stage in analysis, and we shall consider later (a) the capital estimates of county library authorities; (b) the frequency distributions of building costs; (c) the detailed effect of delay in planning and (d) the problem of partly completed works. I mention these other limitations at this stage to show that the problem imposed by using per capita statistics was not the only problem relevant to the use of the Society of County Treasurers' Capital Expenditure Statistics, and that most individual cases had to be examined specifically by (i) letters to county librarians; (ii) use of the capital estimates and accounts; (iii) examination of individual building programmes and the use of considerable other primary data. For the present I shall examine the problems of (i) non-relevance and (ii) non-comparability.

4.2(i) Population, Area and Capital Expenditure.

One expects near-perfect correlation between capital expenditure and population size of county authorities because of the large size differences in the variable, and thus the question of non-relevance is a comparative one. Revenue expenditure usually correlates with population size, but a study of categorised revenue expenditure of London where population size differences are much less than they are for counties, showed it to be conclusive that although (i) educational expenditure correlated positively with population size, that on social services (ii) had a higher negative correlation with the area of the borough than its (almost zero) positive correlation with population size, probably because social service demands were greater in areas of high density.

If this is so even in the case of revenue expenditure, we need to question whether population size is more relevant to capital expenditure on libraries than is the area of the county authority concerned. Libraries are not constructed because of population density, but because of problems of accessibility, and although Clough used membership statistics for library location (82) it is clear that many capital projects are determined by inaccessibility of existing libraries because of distance, and are therefore a function of area rather than of population size. (90f).

(90f). 'Function' is here used simply to mean that capital expenditure correlates more significantly with 'area' than with population size, because of the accessibility factor.

This logic may also be extended to mobile library frequency per capita. It will be shown in the chapter on mobile libraries that, ~~that~~ the frequency of mobile libraries is more a function of acreage than of population size in the case of small counties, and then that even for all 39 shire counties of England and Wales, using 1975/76 data, there is greater correlation between the frequency of mobile libraries and acreage (0.671) than there is between the frequency of mobile libraries and population (0.531) though the linear regression equation that best fits the data is

$$Y = -0.116 + 7x_1 + 7x_2 \text{ ; where}$$

Y is the frequency of mobile libraries;
x_1 is a 'million' unit of population; and
x_2 is a 'million acre' unit of county size.

The actual correlation of fixed service point frequencies with population and area differs respectively in the cases of central, full-branch, part-time service point and institutional libraries, and though the results of the study are interesting I reserve them to the chapter on library buildings. It is sufficient at this stage to give the result of a study of the regression of county capital costs on county population sizes using the data for 1972/73 before large price increases affected and curtailed the capital expenditure of counties. For this year the regression equation that best expressed the relationship between capital cost and population size was:

$$Y = £(1,079,962 + 14X)$$

where Y is the capital cost (aggregate) for each county; and X the <u>unit</u> population of the county.

This regression equation is appropriate to 1972/3 but less appropriate to later years, and for the purpose of calculation the sample consisted of the 58 pre-redistribution counties of England and Wales. London was excluded as a special case.

The equation shows that in the case of capital costs generally the ratio:

$$\frac{\text{Cost of Capital Investment per Annum}}{\text{Size of Population}}$$

is an adequate but not entirely scientific method of comparison between one county and another, for, though there are usually more significant correlations between capital cost and population size than between capital cost and geographical size, the position is reversed, not only, as I have shown, in the case of mobile libraries, but also in some categories of fixed service points. The standard is adequate for the correlation proposed in the next chapter, but must be abandoned for specific sub-category comparisons.

The regression of capital investment with population size for 1972/73 is an illustrative one. Space prohibits detailed examples of later regression. Tests using later data showed that for the years to 1976/77 the regression constants for the intervening years varied from £1m to £2.5m and the regression coefficients varied from £14 to £22.

The conclusion of this subsection on non-relevance is that we must consider both population size and geographical size when making inter-county comparative studies, but that the variable value ratios relative to population size are adequate for this primary study.

4.2(ii) The problem of non-comparability

If there is complete comparability between large and small population-sized counties it would follow that the optimal capital expenditure per capita for a small county is identical to that for a county four times as large. Yet economies of scale may render the real optima significantly different from each other. In this study of English and Welsh counties for the period from 1969/70 to 1973/74 it will be illustrated, where appropriate in subsequent sections, that the ratio of capital expenditure was generally less (for libraries) in the case of large counties than for small counties. Yet the rate of capital expenditure per head of population increased for very large counties, and an optimal size of county was indicated at about 500,000 .

Because of these two limitations, it is preferable not to use the values of capital expenditure per capita in isolation, but also to consider the behaviour of absolute values of capital expenditure. This poses the real problem of partial correlation with population size, but the use of absolute values has many desirable features.

A second strategy is that when using either absolute or ratio values of this variable we examine carefully the differences between the typical values for large and small counties. This involves stratification on the basis of populktion size, (i) to reduce partial correlation with population in the case of absolute values; and (ii) to assess optimality (or at least typical performance) in the case of ratios (i.e. per capita values). (90g).

4.3 Capital Expenditure Values in the Two Termini a Quo.

In chapter three we selected two years for studying the issue statistic. Let us examine the performance and characteristics of capital expenditure during those two years. Apart from the effects of inflation there is not toomuch difference between the frequency distributions for 1969/70 and 1970/71, For the purpose of compilation I relied initially on the publication Capital Expenditure Statistics, but had to adjust values (i) because of reporting differences from primary sources; and (ii) because some adjustment was necessary to effect comparison with the 39 post-redistribution counties. Because of the similarities between 1969/70 and 1970/71 I propose giving brief details of 1969/70 values of the variable and using 1970/71 values for more detailed analysis. It is not possible to subject the variable for both years to all treatment because of shortage of space. It is sufficient to say that similar tests were used for both the 1969/70 and 1970/71 data.

(90g). It does not necessarily follow that either of the 'per capita' values will be 'optimal', but they will, be at least, be 'typical values' for large and small counties respectively, against which individual values can be better assessed.

Table 21 was compiled from Capital Expenditure Statistics for 1969/70 and gives the frequencies of the 58 English and Welsh counties in relative terms for the interval categories, 0 and under 5p, 5p and under 10p etc. per head of population in respect of capital expenditure on libraries. Although the frequency distribution approaches a geometric distribution (i.e. where f is the inverse of x, and where fx is near constant) it can also be approximated by a Poisson distribution with a very low value of λ (=np). For the purpose of compilation, the published frequencies were, in this case, in absolute terms, and were converted to 'per capita' values. In the process of conversion some adjustment of values was necessary because of disparities between published data, and primary data obtained from some of the counties. This did not affect the values of mean, median, mode, standard deviation and coefficient of variation significantly.

For this particular year the modal interval class was '0 and under 5p' per head of population, but the median was 5.5p. and the mean was 7.5135p. As the standard deviation was 7.5467p. it can be seen that the coefficient of variation slightly exceeded 1., (i.e. 1.004). This high value of the coefficient is not simply evidence of a large dispersion of values, but is more particularly evidence of the highly asymmetric nature of the frequency distribution. In this context, the mean value 7.5135p is atypical despite the fact that it could be used by the authorities, for comparative management purposes. The highly asymmetric nature of the frequency distribution is a particular attribute of capital expenditure on libraries, for, in some cases, large sums are spent over small periods by small authorities, thus producing very high values for a few authorities, but where there are no construction plans, where the authority has a large population, and the only capital expenditure is spent on less ambitious schemes for the rebuilding of existing libraries, the amounts per head of population are very small. Thus, the mode of the distribution is in the '0 and under 5p' interval class.

The asymmetry is so pronounced that statistical treatment is difficult. One method of reducing the asymmetry, and some general abnormality in the distribution is to remove Welsh counties from the sample. I have already explained that Scottish and Northern Irish counties have been excluded because of lack of comparability in later years, resulting from the different redistribution legislation resulting from the effects of the Wheatley and Macrory Commission reports. Welsh counties must be excluded for a different reason. The values of capital expenditure of Welsh counties on libraries per capita are either (i) very low; (ii) modal or (iii) very high. It is difficult to explain this distinction in the case of 1969/70 statistics because the lowest interval class is the modal class. In the case of 1970/71 it is easier to show the effect of Welsh counties on the frequency distribution. Table 22 shows the absolute and relative frequencies of the interval classes of capital expenditure when Welsh counties are (a) omitted and (b) included.

It can be seen from Table 22 that with the exception of the tail the frequency distribution of English counties resembles an a symmetric frequency distribution, but that when Welsh counties are added the distribution becomes abnormal because of the tritomous (i.e. three category) division of Welsh values, which I have already mentioned. Thus, although the modal interval class for this year is '5p and under 10p per head of population', yet the mean expenditure varied. It was 11p for English counties, 15p for Welsh counties and 12p for English and Welsh counties combined.

Thus, though the mean value is calculated and published in the Society of County Treasurers' Capital Expenditure Statistics, it is of less importance than the mode. (90h) Further, if we abandon consideration of the mean because of the effect of 'abnormal' values, and attempt to use

(90h). A distinction must be made between the mean of 'per capita' values of the variable, and the aggregate mean, i.e. aggregate capital expenditure divided by total population. The former is unreliable. The latter, used in published statistics, is less meaningful than the mode.

the English counties for model building, there is some proximity to a Poisson distribution where r is a 5p interval class and λ = 1.6, but where the first class (r = 0) has the equivalent in the model for the interval class '0 and under 5p'. Thus, a constant k becomes effectively the midpoint of this class (k = 2.5p); and the approximation is:

$$f(x) = 2.5p + \left[(e^{-1.6}\ 1.6^{r})/r!\right] \times 5p.$$

The mean of the distribution is thus 2.5p + (λx 5p) which simplifies to 2.5p + (1.6 x 5p) = 10.5p and agrees with the mean of 11p that was calculated for this distribution. The value of the interval class '0 and under 5p' becomes that for r = 0 using λ = 1.6, and is 0.2019, which accords with 0.200 in the table. That for the class '5p and under 10p' becomes that for r= 1, and is 0.3230, which approximates to 0.333 in Table 22. Similarly, that for the class '10p and under 15p' accords with r = 2, and is 0.2585. This value is near to 0.244 in Table 22.

Table 23 provides the Poisson equivalents for each of the class intervals using the above modification of the formula for the Poisson distribution. Comparison of the expected frequencies for English counties in Table 23 with those in Table 22 will show that this model is not as consistently similar to the Poisson distribution as that for issues of books per unit of population discussed in the previous chapter.

Yet when the frequency distribution was tested with formulae for all other known frequency distributions the Poisson distribution formed the best basis for a model. The only other near approach to a predictive model was that of a frequency distribution whose reciprocals were distributed in the form of a Gaussian (normal) curve, and whose mean is therefore 'harmonic' in nature. But, as I shall show, this alternative was not backed by evidence from other years.

Table 24 is a tabulation of the means, standard deviations and coefficients of variation for some of the more important capital expenditure category variables for 1970/71. All values are expressed per head of population. It has already been suggested that although the coefficient of variation is primarily a measure of variation, it has some use as a prima facie measure of skewness. The reason for this inference is that because all values of the variate are positive the range must be positive, and if the distribution were symmetric the coefficient of variation would not exceed 0.3. Using this prima facie heuristic rule it may perhaps be assumed that because the coefficients of variation for (i) aggregate capital expenditure per capita (i.e. that on all services) and (ii) capital expenditure per head on education are below 0.3 the frequency distributions of these two variables are 'normal'. Detailed study shows that even this is not the case. For example, the frequency distribution of aggregate capital expenditure per head of population has a mode of approximately £10, but its mean is £11.41 (£11.36 using the less accurate published statistics), and its range is from £7 to £26, only two values of the variable falling above £20 per capita.

The frequency distribution can therefore be assumed to be positively skewed, affected by extreme values and the correlation coefficients must be treated with caution because they may be affected by extreme values. A correlation matrix constructed using all categories of capital expenditure for 1970/71 per head of population showed that most categories competed with each other for capital usage, and that inter-category correlation coefficients were either low, zero or negative. Some features in the correlation are useful and relevant to discussion. Thus, there is negative correlation between capital expenditure on welfare services and most other categories, and there is a good positive correlation between aggregate capital expenditure and that on education (0.496) and between aggregate capital expenditure and that on highways (0.850). The former is probably because the largest proportion of aggregate capital expenditure is on education; and the latter is because there is partial correlation of both (a) aggregate capital expenditure and (b) highways expenditure and (c) the geographical size of county.

The most important result relevant to libraries is that capital expenditure on libraries is a '<u>residual</u>' allocation, not in the statistical sense, but in the more colloquial meaning, viz. that money is only spent on library investment if it can be made available from what are popularly thought to be 'more essential' services, and taking up proportions of aggregate available capital resources between 1% (in the case of Rutland) and 3% (in Norfolk, Huntingdon and Peterborough) for 1970/71. But proportions vary considerably for later years, for individual cases, though the largest proportions are never very high.

The year is a terminus a quo, and as such is important for the purpose of analysis. Before leaving our consideration of it, it is advisable that we make an intra-class-interval study of the characteristics of the counties that spent (i) significantly low, (ii) below average, (iii) above average and (iv) significantly large amounts. To achieve some parity between sample sizes for the Student's <u>t</u>-distribution values it was decided to add one value of 5p to the interval class '0 and under 5p', thus increasing sample size from 9 to 10. The group in this class interval of 'poor' capital investors in libraries during 1970/71 were Rutland, Westmorland, Isle of Wight, Lincolnshire (Holland), Oxford, Cambridge, Northampton, Stafford, Kent and Yorkshire (West Riding). There is no common characteristic for these counties. There is a high correlation coefficient between population size and capital expenditure per capita on libraries (0.793); and an even higher coefficient between the logarithms of values of the variables. There is some reason for this. Very small counties may have hardly any capital expenditure when they have no building programmes, but considerable per capita expenditure when they do. They are thus identifiable with the smallest values in this interval class. Larger counties in this class are those with pre-existent libraries where capital expenditure was low because of (i) diminished library needs and (ii) other capital priorities. Their outlay values tended to be higher than those for small counties. Although I regard this interval class as significantly low, the use of the Students t test does not indicate significance at the 1% level, and it must be remembered that the substitution of the mode (i.e. typical value, = 7.5 for this distribution) in place of the mean (= 11) would reduce any question of statistical significance even further.

The second 'interval class' to be studied was the set of counties comprising the 'modal' group, whose capital expenditure values varied between 5p and 10p per capita, and consisted of Hereford, West Suffolk, East Suffolk, Bedford, North Yorkshire, Dorset, East Sussex, Devon, Leicester, Wiltshire, Northumberland, Somerset, Derby, Hampshire, Surrey and Essex. The characteristics of this group were typical of those for all groups, and most categories of capital expenditure were negatively correlated to each other, indicating competition between expenditure categories. The only exception was that there was a high correlation coefficient (0.874) between capital expenditure on highways and aggregate capital expenditure (for probable reasons given earlier). Library expenditure and expenditure on all other capital categories were negatively correlated, indicating that library expenditure was possibly considered a 'residual' need after other 'major' needs had been satisfied. To provide one example, the correlation coefficient between capital expenditure on libraries and that on highways was -0.301. This is not highly significant using Fisher's conversion of the t-statistic where n = 16, but at least shows the competitive nature of capital expenditure on libraries with that of other categories in this interval class.

For statistical purposes the next two upper interval classes, i.e. 10p and under 15p, and 15p and under 20p were combined. In this way sample size was increased, but there was no loss of power in the test, for both interval classes are higher than the mode although the mean falls in the lower of the classes. They are, in general, counties whose capital expenditures per capita are higher than the typical value, and comprise Lincolnshire (Kesteven), Cumberland, East Yorkshire, Salop, Cornwall, Lincolnshire (Lindsey), Worcester, West Sussex, Gloucester, Buckingham, (90i) Nottingham, Hertford, Cheshire and Lancashire. The most interesting feature of this group is that it consists of a significantly large proportion of counties whose issues per capita are also higher than normal, and whose libraries both follow progressive policies and were quick to respond to requests for information.

It does not, of course, comprise the extreme cases, those whose capital expenditure per capita was higher than 20p during the year 1970/71, but there is no reason why this set should do so, for a time-series study of other years showed that:

(i) no county sustained capital expenditure in the 'extreme' tail of the distribution (i.e. over 20p per capita or its later inflationary equivalent) for more than three consecutive years with the exception of Durham; and

(ii) the upper extreme interval classes usually consisted of counties where the statistics had been affected by expenditure of large sums on administrative buildings and central headquarters in one particular year.

Again, in this pair of interval categories '10p and under 15p' and '15p and under 20p' there was:

(i) negative correlation between capital expenditure on libraries and that on most other categories (for example -0.37 between library and highway expenditures, or -0.416 between the logarithms of the expenditure values); but

(ii) evidence that, in a large proportion of cases, the

(90i). The policy of Buckinghamshire changed later in the period. I discuss this when dealing with bookstocks.

issue statistic ranged above 15 books per head of population, though there was no method, at this stage, of discerning whether this resulted from, or contributed to the need for capital expenditure. In Hertfordshire, for example, the statistic decreased slightly in later years. (90j).

Further, although the evidence under (i) above seems to suggest, particularly, a negative correlation between capital expenditure on highways and that on libraries, for example, the regression equation which best fitted the data was:

$\text{Log } Y = -0.793 - 0.164 \text{ Log } X$; where

Y represents capital expenditure per capita on libraries; and

X represents capital expenditure per capita on highways;

there was no overall reason why, in these counties libraries and highways should compete for relative use of aggregate funds more than any other pair of capital expenditure categories.

It should be said, incidentally, that aggregate funds were not significantly greater than those for all other English counties. For these two interval categories the aggregate mean was £11.345 per capita in comparison with £11.411 given in the Table 24 for all counties. Thus, the higher provision that these counties made in 1970/71 for libraries was not a function of greater overall funds for all capital categories, nor was it a function of a capacity that these counties may have had to raise extra money to be spent, inter alia, on libraries. Instead, it showed that the higher relative capital allocation for libraries was a matter of deliberate policy.

Finally, let us examine the counties whose expenditures on libraries exceeded 20p per capita in 1970/71, those in the 'tail' of the Poisson curve. These five cases were not related to issues per capita, to population size or to any other variable, and, with the exception of Durham, they were not consistently high library investors. They were, in 1970/71 Berkshire (28p), Durham (39p), Huntingdon (44p)

(90j). The reported decrease was, in some cases, more apparent than real, resulting partly from the exclusion of schools issues, but Hertfordshire is quoted to show that there is not a necessary association between the variables in all years.

Norfolk (28p) and Warwick (21p). Although in these cases there was higher absolute capital expenditure on libraries, there was lower relative capital expenditure on libraries, for the aggregate mean was £12.99 as compared with £11.411, and although this is insufficiently high to be regarded as significantly different using the t-statistic (1% critical value where n = 5, and ν = 4) it suggests that library expenditure is a 'residual' satisfied after the 'major services', and that if more money is available, disproportionately more is spent on libraries, while if less money is available, libraries suffer acutely. Further evidence of this hypothesis is provided in the statistics for later years.

In this case, the correlation between aggregate capital expenditure and that on libraries was positive (0.981), and further the correlation between capital expenditure on libraries and highways was also positive (0.942). Even where ν is only 4, both coefficients are significant at the 1% level, and the suggestion is that the expenditures on both these 'residual' categories, highways and libraries, are a disproportionate function of the greater availability of aggregate funds.

Before proceeding to a population size classification of the data for 1970/71, we may summarise the position briefly. The frequency distribution of the variate, capital expenditure per capita, is a variant of the Poisson curve. A reclassification into four interval classes showed that the lowest class consisted of either (i) small counties or (ii) larger counties whose capital needs were small during 1970/71 and that there was a positive correlation between capital expenditure per head of population and population size. In the second (i.e. modal) class there were no distinct features apart from (i) a high correlation between highways and aggregate capital expenditures but a negative correlation between highways and library capital expenditures, and therefore (ii) a possibility that library investment is a 'residual' satisfied after the needs of the major categories. The third class (that combining two classes immediately above the modal group) included (but not exclusively) a high proportion of counties with progressive policies whose issues per capita exceeded the mean values of the variable even at the outset of the period. There was a higher negative correlation between highways and library expenditure, but no available explanation apart from the probability that highways and libraries form 'residual' bids for relative proportions of aggregate capital funds after major categories' needs (e.g. education) were satisfied. The aggregate mean was not significantly different from that for all counties, so that the higher capital expenditures resulted from deliberate policies

Finally, the extremely high interval classes of capital expenditure could not be generalised as those with higher issues per capita or even, with the exception of Durham, as consistently high spenders. The mean aggregate capital funds available were higher for these five counties, and the higher correlation coefficients with (i) aggregate funds and (ii) even highways showed that these two 'residual' categories received disproportionately high relative allocations of aggregate capital funds after all major needs had been met.

Before proceeding to other years it is necessary that we deal with the limitation of our analysis (using the 'per capita' values of the variable) suggested in 4.2(ii) that small counties may have different optima from large counties. It will be recalled that limitation 4.2.(i) was answered by the argument of lack of statistical significance except in sub-categories of capital expenditure (e.g. mobile libraries) but limitation 4.2(ii) was not answered. Can comparable per capita criteria be used for large counties as those for small counties? It is necessary that we use disproportionate stratified sampling for this purpose, because of population 'weights'. To divide the 45 English counties into two categories whose total populations are near-equal it is necessary to use the mean for the pre-redistribution counties (530,000), for the purpose of interval classification, for though this classification naturally resulted in a larger group of small counties ($n_1 = 29$) than of large counties ($n_2 = 16$) it was the only method of ensuring that the counties' populations received equal weighting. Prior to (901). the use of the mean, a median test (the non-parametric test described in chapter 3) was applied to test the frequencies of counties whose capital expenditures per capita fell above and below the median for counties classed in respect of median size, and the criterion of median capital expenditure was then extended to counties classified in terms of the mean (as above). There were no significant results of either of these tests, but Table 25 will show that there are strong differences between the absolute frequency distributions of the capital expenditures of large and small counties.

It will be seen that, for small counties:
(i) the mode is lower than that for large counties; and
(ii) the range is larger than that for large counties;
because:
(i) smaller counties have less frequent capital projects; and
(ii) smaller populations obviously entail higher relative capital costs per head of population.

Although there is acute difference in frequency distributions of capital expenditure on libraries because of comparative infrequency of library projects, there is substantial difference in the variation of aggregate capital costs. Again, taking 1970/71 values, the coefficients of variation for aggregate capital expenditures per capita are:

(i) for the small counties, $\dfrac{£4.235}{£11.483} = 0.37$; but

(ii) for the large counties, $\dfrac{£2.437}{£11.281} = 0.22$.

The variation for library expenditure is even greater than it is for aggregate capital expenditure.

(901). The term 'population' is here used in the common demographic sense, not the specialised statistical sense.

This study immediately suggests that, although one can apply identical mean criteria to large and small counties, the variability of small counties cannot be monitored by using criteria that apply to large counties.

If one examines the group of large counties one sees that the mode is higher, but not significantly so. Further, in this group there are low correlation coefficients between capital expenditure on libraries and that on other categories, except highways, where the coefficient is positive but not significant at the 1% level (i.e. 0.57 where n = 16). This suggests that for large counties particularly, both these categories use 'residual' funds after the capital needs of the major categories have been satisfied. This result is important for it is less affected by extreme values than that of the set of 25 small counties. In the latter case analysis was restricted by the variability of the values and the small size of the sample.

Thus we can conclude that although per capita means do not differ for large and small counties, the use of per capita values is seen to suffer from the problem that the variable values are more widely dispersed for small counties than for large counties.

A part-solution to the problem is to use absolute capital expenditure values and assess (despite their high partial correlation with population size) whether counties in the four interval classes of capital expenditure that were detailed earlier differ widely in terms of aggregate and library absolute expenditures.

The study of this problem was considerable, but a few details of discoveries are provided because of lack of space.

In the interval of counties whose capital expenditures per head of population were lower than the mode (n = 10) the correlation coefficient between absolute capital expenditure on libraries and the absolute aggregate for all categories was 0.752. In this interval class, the correlation coefficient between absolute aggregate capital expenditure and population size is 0.974, and the linear function expressing aggregate absolute capital expenditure in terms of population size is:

$Y = £(492,886 + 9X)$; where

Y is aggregate capital expenditure in absolute terms; and

X is each additional unit of population.

In this exceptional case there is a good linear correlation (0.752) between aggregate capital expenditure (absolute) and absolute capital expenditure on libraries, because of size.

Using the above regression line as a test of each of the 10 values of the variable to see whether those exceeding the above regression estimate exceeded the median capital expenditure for libraries, it was seen that the four frequency sub-categories for the application of Fisher's test were respectively that 3 exceeded expected values for both criteria; 2 each exceeded expected values in only one criteria and 3 failed to satisfy both criteria. This result is not even significant where P = 10%. Further, the counties fall into the same categories if the logarithmic correlation coefficient is calculated between absolute (90m) aggregate capital expenditure and population size (0.959) and the appropriate regression equation used:

$$\text{Log } Y = 0.890 \text{ Log } X - 1.363$$

where the variables X and Y are as stated earlier.

Thus the apparently good correlation coefficient between aggregate capital expenditure and absolute capital expenditure on libraries is purely the result of correlation with population size.

The modal interval class was tested using similar criteria. For this class the correlation coefficient between capital expenditures on libraries and highways (0.41) was explained purely by partial correlation with population size. In this interval class the regression equation that best approximated to the data for all values was linear, vis:

$Y = £(691,533 + 9X)$

where the variables X and Y are as stated earlier.

(90m). The criterion of having higher or lower absolute spending than a given 'regression' estimate is no less powerful a test of spending, than comparison with a 'per capita' average.

Note that the regression coefficient for this interval class is approximate to that for the lower interval class. There is an increase in the regression constant. Further, although there is, in this case, a smaller positive correlation between aggregate capital expenditure and capital expenditure on libraries in absolute terms (0.47) this is explained by partial correlation with population size. For valid criteria of application of a test of frequencies of library authorities that exceed or are less than regression estimates with those that exceed or are less than the median capital expenditure per capita on libraries (7.50p) indicate that there is no significant association between the four categories if Fisher's test is applied.

The third class (those above the mode, but not extremely high) were tested with similar criteria and again the highest correlation coefficient between absolute library expenditure and that on any other capital category was with highways (0.645) but this was mainly attributable to joint correlation with population size. For this interval class the best regression equation to give the relationship between population size and aggregate capital expenditure was

$Y = £(13X - 503{,}187)$

where the variables X and Y are as stated earlier. There is a negative regression constant because of the steep association between population and aggregate capital expenditure values. But other functions, logarithmic, square, square root etc. were attempted and provided no better approximation to the data. Again, when the regression estimates provided by this equation were used to determine high and low frequency categories for a 2 x 2 non-parametric test with capital expenditure (per capita) on libraries, the results of Fisher's test were not significant.

Finally, the fourth interval class (extremely high values of capital expenditure on libraries per capita) was tested and the regression function was similar to that of the third interval class:

$Y = £(13X - 54,133)$,

but there was no significant intra-class association between library expenditure and aggregate expenditure.

However, if we now examine the inter-class association an interesting feature has emerged. It is that, although the per capita values are not too reliable statistically because the relationship between aggregate capital expenditure and population size is expressed by different linear (and in one case logarithmic) functions, yet:

(i) the two interval classes that have low per capita expenditures on libraries also have low regression (i.e. 9X) coefficients expressing the relationship between aggregate capital expenditure and population size; and

(ii) the two interval classes that have high per capita expenditures on libraries also have high regression (i.e. 13X) coefficients expressing the relationship between aggregate (i.e. all categories) capital expenditure and population size.

There is thus, a non-linear overall association between capital expenditure on libraries and aggregate capital expenditure, indicating that where more funds are made available it is generally true that a larger amount is spent on libraries after all other (major category) needs are met, but that it is an inter-category rather than an intra-category association between the variables.

Finally, it may be questionned why library expenditure was not treated in terms of absolutes, and each absolute scale value measured against an absolute regression estimate, as in the case of aggregates. The answer is simple. It is that there is a surprisingly low correlation coefficient between capital expenditure on libraries (in absolute terms) and population sizes, and that 'per capita' values are therefore much more appropriate. The best correlation coefficient between capital expenditure on libraries and population size was a logarithmic coefficient (0.445) and with an overall F-value of 10.636 for regression, the logarithmic equation is:

$\text{Log}Y = -3.944 + 0.505 \text{ Log } X$

for determining capital expenditure on libraries, as against a much higher correlation coefficient between aggregate capital expenditure (on all categories) and population size, i.e.

$\text{Log}Y = -1.935 + 0.995 \text{ Log } X$; and

where the correlation coefficient between LogX and Log Y is 0.948.

Thus, it was decided that the use of the regression line as a test of whether the value for each county exceeded or did not meet the regression estimate, would not provide more powerful test criteria than the simple use of the median 'per capita' value for each interval class.

In summary, in the latter part of this section of the chapter (4.3) the interval categories (using the 'per capita' conversion of the capital expenditure on libraries) were reconsidered in terms of:

(i) classification using population size; and

(ii) correlation of aggregate capital expenditure with population size;

so that problems imposed by using the 'per capita' conversion of the statistics could be remedied.

Using (i) it was shown that although large and small counties had near-identical mean values of capital expenditure per capita on libraries, small counties had a lower mode, but a wider dispersion, thus limiting the value of inter-county comparison, using values per head of population.

Using (ii) it was shown that there was not a significant intra-class association between aggregate capital expenditure and capital expenditure (expressed per-capita) on libraries but that the regression functions varied for each of the four interval classes, and the regression coefficients were larger (for expressing aggregate capital expenditure in terms of population) for counties whose per capita expenditures on libraries were large, than for those whose per capita expenditures on libraries were small. But the association was not a linear one.

It was explained that while regression estimates were more powerful than per capita statistics for testing the performance of each county for aggregate capital expenditure, it was not considered that regression estimates would be more useful than simple ratios per head of population when testing capital expenditure on libraries, for the correlation coefficient between population size and absolute capital expenditure on libraries is low.

Thus, by the best criteria that could have been adopted for this unusual study, there is an overall inter-class association between aggregate capital expenditure and that on libraries, but it is non-linear and does not persist in intra-class simple (non-parametric) frequency studies using two-way tests.

Intra-class studies have shown, given the limitations of comparability between small and large counties, that this correlation does, however, approach linearity for counties with exceptionally large library expenditures, but that most intra-class studies show a possible association between library and highway expenditures, only because they are 'residual' demands to be satisfied after 'major' category needs (e.g. education) are met. Generally all capital expenditure categories are competitive, and we should proceed with this in mind.

4.4 Capital Expenditure Values in 1971/72

The peculiar frequency distributions of the previous section necessitate our study of not only the termini a quo and ad quem of our period, but also examine intervening years, though because of lack of space we shall not recount the analyses of data for these years with the same detail for many of the conclusions reached were identical with those for 1970/71. Table 26 shows the frequency distribution for England and Wales for 1971/72. It is both asymmetric and irregular, though a nearer approach to 'normal' asymmetry may again be achieved by the exclusion of Welsh counties. It is bi-modal at the interval classes '10p and under 15p' and '20p and under 25p'. The median is £13 and the mean

£14.50p for all categories of capital expenditure for 1971/72, giving a monetary increase in the unweighted mean aggregate capital expenditure by 27% from the 1970/71 mean (= £11.41) to the 1971/72 mean (=£14.50). If this is adjusted for inflation the real increase is only 17% (using the mean of relevant inflation indices). Of course, the mean aggregate capital expenditure per head of population (unweighted) is a less typical indicator than either (i) the mode or (ii) the mean aggregate capital expenditure weighted for size of county, but it may be used with reservation, for the frequency distribution of aggregate capital expenditures per capita is less skewed than that for libraries only. It may safely be said that there was an increase in the real provision for all capital expenditure categories (measured per capita) even though property values increased at greater pace than the inflation indices.

Against this background, the unweighted mean of capital expenditures per capita on libraries increased by 69% from 1970/71 (11.04) to 1971/72 (18.77), and this approximates 59% when adjusted for inflation. This unweighted mean is atypical for it has been affected by the extremely large value for Rutland (£1.37) and some Welsh counties, and differs from the weighted means of Tables 34 and 35, of Section 5.2. and the published Society of County Treasurers' Capital Expenditure Statistics. Yet when this change is compared with that between 1971/72 and 1972/73 it may be evidenced at the 5% significance level that an increase in aggregate **available** capital expenditure produced a disproportionate increase in available capital for libraries. It was asserted earlier that the low correlation(r= 0.191) between aggregate and library capital expenditures indicated that libraries were a sensitive 'residual' to be satisfied after other (major) categories, An aggregate capital increase effects a greater increase per head

of population on libraries. Libraries are thus high geared investment, taking up surplus capital investment after major (more constant) capital category needs are met. But the hypothesis should also be tested by reference to correlation coefficients for if it is correct there should be a much more significant 'per capita' correlation between library investment and aggregate investment than in 1970/71. Table 27 provides a correlation matrix which shows that
(i) there was greater correlation between aggregate capital expenditure and all categories for 1971/72 than 1970/71 for even in a major category, education, the coefficient increased from 0.496 to 0.582; but that
(ii) for minor 'residual' categories the increase in coefficients was much greater, indicating disproportionate sensitivity of these categories (libraries and highways) to increases in funds, (e.g. libraries from 0.191 to 0.506); and
(iii) the minor categories (libraries and highways) were highly correlated to each other because:
(a) they were both much more sensitive than the major categories (e.g. education) to the increase in funds as against 1970/71;
(b) both variables are partially correlated to urban development (i.e. libraries would be developed in areas where highways would be developed); and
(c) there could be a stochastic element in the coefficient.
The 1971/72 data were subjected to a class-interval study of differences of capital expenditure on libraries but the results were similar to those for 1970/71. In addition, it was decided that the data be classified to study the differences of population size more closely than in the case of 1970/71. For this purpose, not all interval classes need be reported, though tests were carried out on all classes. This stage of the report deals with matters that are relevant to our main study.

The lowest class consisted of counties whose populations were less than 50,000 (i.e. Merioneth, Montgomery, Radnor and Rutland). Two of these counties had significantly larger capital expenditures per capita (Radnor = £1.26p and Rutland = £1.37p) than the mean for all counties

(18.77p), but the mean capital expenditure (aggregate) was £22.72p and significantly higher than the aggregate for all counties in either 1970/71 (= £11.41) or 1971/72 (=£14.50). Both the counties mentioned had large central library building programmes and small populations, but despite this there is an inference that library expenditure is highly sensitive to the availability of funds.

The second interval class '50,000 and under 100,000' consisted of Anglesey, Brecon, Cardigan, Pembrokeshire and Westmorland. Though the relevant means for aggregate capital expenditure (= £18.97p) and libraries (=20.2p) are larger than for all counties, use of the t-statistic at $n = 5$, $\nu = 4$ does not indicate that they are significantly higher. Thus, there is, as in the case of 1970/71, no inverse correlation between population size and capital expenditure per capita (either aggregate or on libraries). However, when both these classes ,'under 50,000' and '50,000 and under 100,000' are combined and when rank correlation coefficients are calculated to obviate the effect of extremely high values, the minor categories, libraries and highways are highly correlated, while there is a negative rank correlation, for example, between library investment and investment in local health ($\rho' = -0.81$). The inference is again that library expenditure is positively sensitive to the increase in aggregate funds, while the major and more essential services are not so sensitive and therefore are negatively correlated with library investment.

The third (modal) interval class consisted of counties sized '500,000 and under 1,000,000'. The interval span is larger than the two earlier ones, and I do not report the interval class '100,000 and under 500,000' because it showed no significant characteristics. In the modal class, however, there was again a high correlation coefficient between aggregate per capita investment and library investment per head of population ($r = 0.487$) showing again, that library investment is sensitive to the greater availability of funds.

Finally I deal with the upper extreme class '1,000,000 and over'. In this class there was also a significant correlation coefficient between capital expenditure on libraries and aggregate capital expenditure (both variables per head of population), r = 0.882, but the coefficients between aggregate capital expenditure and the 'major' categories of capital expenditure were larger than for other classes (e.g. as high as r = 0.811, for education). Thus, although more funds were available in these very large counties, the disproportionate sensitivity of library investment was not noticeable because the counties were large.

Other research matters were pursued apart from the study of capital expenditure class differences, where the results are similar to those of 1970/71 and therefore not reported, and the study of population class differences, which has been reported in detail. Tests were conducted that involved the calculation of correlation matrices from the reciprocals, squares, logarithms and square roots of the values of all the variables, but most of these tests indicated low F-values and the research was not pursued.

In summary of section 4.4,although capital expenditure class differences were studied with results similar to those of 4.3 (1970/71), reporting has been confined to the study of some different population-size classes. The main feature of 1971/72 is that more funds were available (even allowing for inflation) and that the minor categories of capital expenditure (libraries and highways) were more sensitive to the increase than major ones (e.g. education). The result is that for all sub-classes studied, library investment correlates positively with aggregate investment and with highway investment but negatively with the 'more essential' and basic categories (e.g. highways and education). Only in the extremely large population-sized counties is there significant correlation between aggregate investment and investment in education, but even here it is not as large as that in libraries. Thus library investment is highly sensitive to increases in available aggregate capital expenditure, and this is evidenced by the disproportionate increase and the high correlation coefficients.

4.5 Capital Expenditure Values in 1972/73.

A 'lag' of several years has been postulated, and if the postulate is correct it is unlikely that capital expenditure subsequent to 1972/73 affects the values of issues per capita in 1975/76. But a study of the frequency distribution for later years is necessary because of the likelihood that some projects spanned several years and were nearing completion at the termini ad quem. Such projects would not have significantly high capital expenditures for any one year.

Table 28 provides the class frequency distribution for capital expenditure per capita on libraries for 1972/73. The distribution is both abnormal and bimodal, and has a platykurtic appearance, the two modes effectively being '5p and under 10p' and '15p and under 25p', but the 'tail' of the frequency distribution is also high -frequencied. Its abnormal appearance partly results from the different ways in which counties responded to capital expenditure restrictions, but adjustment for 'problem' cases that were individually considered later indicates positive skewness. The higher variability was partly a function of inflation, and the 'mode' of the distribution '5p and under 10p' was lower in real terms than that for 1971/72. But, because the distribution has another, smaller, mode at '15p and under 25p', there was an effective real increase in the typical expenditure value.

Further, the mean aggregate capital expenditure rose from £14.50p per capita in 1971/72 to £18.21p per capita in 1972/73 by 26%, but by 11% after adjusting for inflation, while the increase in capital expenditure on libraries was again over-sensitive to this increase.

This is indicated by the fact that there was again a disproportionate increase in expenditure (per capita) on libraries. The mean capital expenditure on libraries increased from 18.77p in 1971/72 to 25.75p in 1972/73, and, in this case the monetary increase was 37%, though the real increase was 22%. This is again an indication that capital expenditure on libraries is oversensitive to variation in aggregate capital expenditure. Incidentally for all four years 1969/70 to 1972/3 the coefficients of variation were considerably higher for capital expenditure on libraries than they were for aggregate capital expenditure or for any of the major capital expenditure categories.

For 1972/73 capital expenditure on libraries (per capita) showed no significant correlation with either (i) capital expenditure (aggregate) or (ii) capital expenditure for any major use. Even the coefficient of correlation between capital expenditures on libraries and highways was only 0.318, and this is significant only at the 5% level.

There was considerable study of the data for this year to discover whether there were logarithmic, harmonic, square, or square root correlations between the variables, and whether the measures of dispersion and location differed significantly between small and large counties. In most respects the tests showed results similar to those of previous years. The correlations between logarithmic, harmonic, square and square root conversions of values of all variables, i.e aggregate, educational, social service, welfare, highway, and library etc. values of per capita investment were not significantly higher than those for linear correlation, but the test of difference between data of small and large counties showed that although the measures of location did not differ significantly the statistics of small counties were much more widely dispersed than those of large counties.

In summary the study of 4.5 showed that capital expenditure (per capita) on libraries is (i) more asymmetric and (ii) more widely dispersed than capital expenditure (per capita) on either (i) aggregate of all services or (ii) any of the major services, and that it is highly sensitive to changes in aggregate capital expenditure, this latter conclusion being firmly evidenced both by the strongly disproportionate effect of an increase in aggregate capital expenditure on capital expenditure on libraries (both between 1970/71 and 1971/72 and between 1971/72 and 1972/73) and by the higher coefficient of variation for libraries than for aggregate capital expenditure or for any of the major categories. Secondly the higher coefficient of variation for the data of small counties for the years 1969/70 to 1972/73 cautions against the indiscriminate use of the 'per capita' statistic for making comparisons between small and large counties.

4.6 Capital Expenditure Values from 1973/74 to 1975/76

It is unlikely that capital expenditure in the last two years of the sequence (i.e. 1974/75 and 1975/76) could have affected the issue statistic during the same years, and thus, although all three years must be studied for ensuring the validity of statistical comparison between the data of all years, they have been reported in the same section as 1973/74 because of their value in studying the effect of the 1972 Act.

For all three years the mean 'per capita' values of both aggregate and library investment were atypical, and higher than the modes of their respective frequency distributions. This is because of extreme values for all three years, 64p and 62p for Durham and Hampshire respectively in 1973/74, when the mean had not risen above 30p because of the effect of local government stringencies; £1.05 for Cambridgeshire in 1974/75 when the mean for all the new shire counties had risen to 31p per capita; and £1.13p for Cambridgeshire, 63p for Hereford and Worcester and £1.24p for Nottinghamshire in 1975/76 when the mean decreased to 29p per capita.

The fall in the mean value is partly the effect of capital stringencies, but partly because the mean became more typical with the formation of larger counties after redistribution; and this is offset by (i) lower real values and thus (ii) the extreme values given for 1974/75 and 1975/76 are not as atypical as, for example, those for Rutland in earlier years. The full effect of the 1972 Act in the creation of new shire counties began to be evident in the data for 1974/75, and though the frequency distributions for aggregate investment are less asymmetric for these years than for earlier years, there is still strong positive asymmetry in the frequency distribution of library investment. The standard deviation of library investment is 21p for 1975/76 and the coefficient of variation is 0.74.

The most prominent 'extreme' value for the three years is Cambridgeshire, but this is not now associated with the effect of capital investment on a small population as in the case of Rutland, but rather with the completion of a new Central Library, which came later than originally estimated, and where even the original estimate had exceeded £750,000.

It is stressed that although the study of capital expenditure frequency distributions for 1974/75 and 1975/76 are interesting to assess the effect of the redistribution on the structure of the frequency distribution, these years are not relevant to the model that will later be proposed, not only because of the theoretical 'lag' that was postulated in chapter three, but because the correlation of the capital expenditure statistics for both these years with changes in the issue statistic using index values that will be explained later, is not significant at either the 5% or the 1% levels of significance.

The most important specific feature of the data for 1973/74 is that small aggregate change in monetary capital expenditure values had the minimum possible effect on library investment. In other words, as library investment had previously been sensitive to increases in aggregate investment, it was, in this case disproportionately sensitive to capital expenditure stringencies. The change in the frequency distributions for the other two years 1974/75 and 1975/76 made comparison difficult, but if the mean values are used these later inter-year comparisons evidence the same conclusion. Thus for all years we may say that capital expenditure on libraries is (i) oversensitive to changes (i.e. increases or decreases) in aggregate capital investment; and (ii) poorly correlated (i.e. competitive) with the major categories of capital expenditure, except for one year 1971/72 for large counties when all categories took up the 'slack' in increased expenditure, but where, even so, major categories are less well correlated to library expenditure as are some minor categories, such as capital expenditure on highways.

4.6a A Study of Absolute Capital Expenditure Values

Before concluding this chapter, we shall, in 4.7 discuss the results of inter-period correlation of the values of capital expenditure per capita on libraries. Earlier, in 4.2 we discussed the problems of using the 'per capita' statistic, and in 4.3 provided some evidence of problems of non-relevance (because capital expenditure sometimes correlates more closely with geographic size than with population size) and of non-comparability, because the per capita values of all capital expenditure variables are more highly dispersed for small counties than for large counties. In 4.3 we showed that aggregate capital expenditure does correlate with population size, but that the linear equations expressing the relationship between aggregate capital expenditure and population size differ between large and small counties. This was true of aggregate capital expenditure, and though it is less true of capital expenditure on libraries, yet we must take into account partial correlation of absolute values of the capital expenditure variable with population size, when examining their significance. In the case provided (1970/71) the correlation of library expenditure with population size was poor because of the effect of the expenditure of Rutland and some Welsh counties. If, instead, we use the other years in the series and adjust for 1974/75 and 1975/76 because of the differences imposed by the new shire counties, the more typical correlation coefficients between (a) absolute (i.e. unconverted) aggregate capital expenditure; (b) absolute (i.e. unconverted) library investment; and (c) population size are given in Table 29, while the logarithmic correlation coefficients (i.e. correlations of logarithmic values) of these three variables are given in Table 30.

The matrices illustrate that, although (a) and (b) are highly correlated because of the effect of population size, the correlation coefficient is, in fact, lower in Table 29, as is its counterpart in Table 30. The correlation between absolute values of the variables also showed, though this is not illustrated in the tables, that capital expenditure on libraries is most significantly correlated with capital expenditure on highways (r = 0.802 - linear), because (i) these are smaller capital categories and are oversensitive to changes in aggregate capital expenditure and (ii) they have significant correlation to (a) area size as well as (b) population size.

A stratified study of absolute values of the variable and their relationship to population size showed widely different correlation coefficients for different sizes of counties. Thus in the stratum of counties of population size 500,000 and under

1,000,000 the linear coefficient between aggregate investment and library investment was r = 0.45, and that between library investment and population size was r = 0.52, because this band consisted of counties, some of which had significantly high library investment, while in the stratum with class interval 1,000,000 and over the linear coefficient between aggregate and library investment was r = 0.735, and that between library investment and population size was r = 0.606

This study reinforced the conclusions of 4.3 that, although it is best, as we have done, for comparative purpose, to convert all absolute values of capital expenditure variables into 'per capita' variables (i.e. per head of population), yet absolute values of library investment variables are less sensitive to population size than are absolute values of aggregate investment variables. Yet, relative (i.e. per capita) variables present limitations to our analysis in being (i) asymmetrically distributed; (ii) more highly distributed for small than for large counties; and (iii) highly (i.e. disproportionately) sensitive to changes in aggregate capital investment; though (iv) well correlated with minor uses of capital funds; but (v). poorly correlated, (i.e. competitive) with most major category users of capital funds.

4.7 An Inter-period Correlation of Capital Expenditures per Capita

In Section 4.5. it was stated that the consideration of capital expenditure values for 1974/75 and 1975/76 in that section was intended to assess the effect of redistribution of counties on the frequency distribution of the variable. For the purpose of 4.7 I intend excluding these years from the correlation matrices that are provided in the Tables, because all research showed that, in any case, for those years capital expenditure was not significantly correlated with increases or decreases in the issues of books per head of population.

When studying the correlation matrices it is again necessary to bear in mind that coefficients may be disproportionately affected by extreme values in the asymmetric frequency distribution. Table 31 gives the inter-year correlation coefficients for the 44 English counties for which data were available for the whole period, while Table 32 provides correlation coefficients for 43 (i.e. those of Table 31 excluding Rutland). The purpose is to illustrate the effect of one extreme pair of values for 1971/72 and 1972/73 on the correlation coefficients for all years. The general purpose for the provision of both tables is to assess whether there was inter-period consistency in county expenditure on libraries (per head of population) from one year to another. If so, we may question the significance of expenditure in any one year, as distinct from the effect of expenditure through the period generally.

We can often assume consistency of <u>revenue</u> expenditure because of the historical basis of estimating, and because library authorities that make high provision in one year tend to do so in future years, or vice versa. In capital investment, this is less the case. We must expect some consistency because one large capital project may affect the rolling programme of a library authority for a number of years, but it is likely that capital expenditure is much less consistent in nature from one year to another than is revenue expenditure. If we employ a one-tail test we may regard 0.25 and 0.36 as useful levels of the correlation coefficient for assessing significance at the 5% and 1% levels respectively.

It is noted that the correlation coefficient between values of the variable for 1971/72 and 1972/73 is only as high as 0.877 because of the effect of Rutland, and that the matrix of Table 32 shows good positive correlation between the capital expenditure for consecutive years (i.e. when immediately paired) for all pairs from 1969/70.

After 1973/74 the correlation coefficients between immediately consecutive pairs are lower. In Table 32 all coefficients, except one, are significant at the 1% level, and immediately consecutive pairs have highly significant correlation coefficients. The employment of sequential F-tests confirmed this result.

If we employ single linear regression estimating to obtain-approximate the relationship between immediately consecutive pairs of years, the relationships are:

(i) $CL_{1970/71} = (7.6 + 0.49 CL_{1969/70} + U_1)p.$

(ii) $CL_{1971/72} = (6.4 + 0.507\ CL_{1970/71} + U_2)p.$

(iii) $CL_{1972/73} = (7.5 + 0.873\ CL_{1971/72} + U_3)p$; and

(iv) $CL_{1973/74} = (6.6 + 0.744\ CL_{1972/73} + U_4)p.$

where: CL_i is per capita expenditure on libraries in year i.
Note that the regression coefficients do not follow the correlation coefficients in order of magnitude.

A study of those counties whose error terms (U_i) are high (either negative or positive) will indicate those that were significantly less consistent than others over the period. For this purpose error terms needed to exceed one standard deviation of all error terms from zero, for each year. Using the 1970/71 equation the values of U were 33.45p for Huntingdon and Peterborough, because of the effect of a very large central project; 8.9p, for East Yorkshire, because of random fluctuation remedied in 1971/72, 18.44p in Berkshire; 13.05p for Durham, which has very large per capita expenditure on libraries for all years in the period and therefore must be treated as an exception to the overall linear model; -15.48p for Bedford, and -9.5p for Hampshire , which is again self-remedying and random, for it has a positive error term for the 1971/72 equation.

To use the 1971/72 equation, we have decreases (or negative error terms) for East Yorkshire (i.e. East Riding) -9p offsetting the 1970/71 error term; for Cornwall -7.5p; and for Warwick -10p; but positive residual errors for Westmorland 17p; for Lincolnshire (Kesteven) 16.7p; for Norfolk 10.4p; for Northampton 13.5p and again for Durham 13.8p, for the reason stated while the positive error for Hampshire 8p partly offsets that for the 1970/71 equation.

Some error terms are not necessarily random as is shown by measuring the significant error terms for 1972/73 where, although the negative term 12.73p for Huntingdon and Peterborough part-offsets the earlier positive (33.45p) term and indicates completion of a large project; and the positive U term 28.89p part-compensates an earlier negative term for Hampshire; Northampton has again a high positive error (16.38p), together with single-year cases Lincolnshire (Holland) 12.6p; Cumberland 24.11p and Leicester 13.62p, all of which can be identified later as single-year spending on large projects; while Isle of Wight (17.6p) positive error also resulted from a large library project and was countered in 1973/74 by a negative error term (-29.05p). Finally, the only other significant regression error was Dorset (-23.11p) resulting from the completion of a project.

A study of individual values of error terms for 1973/74 shows that the only significant negative error term for Isle of Wight (-29.05p) resulted from the completion of a project, that the increase on the regression estimate for Warwick (55.92p) partly offset an earlier regression error, and that the other two high error terms, 31.35p for Buckinghamshire, and 29.03p for Cheshire resulted from the commencement of capital projects.

Thus, throughout the period capital spending on libraries was surprisingly consistent, and the regression errors of single period regression show that many significantly high errors were self-compensating over the five-year period. The use of linear equations for this study may be questioned, but I have used them (i) because they are easier to explain in this report; and (ii) because attempts to correlate the logarithm, harmonic, square and square root values of the variables did not isolate different counties as cases where positive or negative regression error terms were significant.

The consistency between counties is thus surprisingly good for the period 1969/70 to 1973/74. This is because, as I shall show later, several large rolling programmes were commenced at the beginning of the period, and had to be maintained despite the sensitivity of library investment to expenditure reductions. But when this period was terminated, the situation altered markedly. It is worthwhile to state that for the years 1973/74 and 1974/75 the interperiod paired-correlation between capital expenditures per capita on libraries fell to 0.473; and that for the pair of variables 1974/75 and 1975/76 it was only 0.308, while the two-year correlation coefficient between the variable values for 1973/74 and 1975/76 was only 0.136, and that between the variables for 1975/76 and that for other years from 1969/70 was for each pair respectively 0.046; -0.093; -0.096 and 0.031. In other words, apart from its barely significant correlation with the capital expenditure on libraries for the previous year, that for 1975/76 was almost zero-correlated with all values of the variable for all previous years. Whatever consistency existed in the policy of counties before and including 1973/74, terminated immediately afterwards.

This consistency is best illustrated by correlation of inter-year paired values of the variable, but is partly evident from reciprocal and logarithmic conversions of the values. The asymmetric distributions are, of course, neither logarithmic nor harmonic in nature, but the use of such correlation coefficients, without the exclusion of Rutland (this being necessary in the linear case) partly compensated for the problem of exceptionally high values. Table 33 provides the coefficients of logarithm and reciprocal transformations of the variable for immediate pairs of years (i.e. those next to one another). It can be seen that the correlation coefficients in Table 33 are not very much higher than they are for Table 31. Similar coefficients were obtained by using the squares and square roots of values of the variables. I mention these attempts at model-building, (for the use of square roots of values of each of the variables lessens the effect of extreme values, but the use of squares of values of the variables exaggerates it) only to illustrate that the isolation of the most exceptional case (i.e. Rutland) and the use of simple linear correlation was the more satisfying method of procedure, and the more justifiable and meaningful treatment of the problem of the asymmetric distribution of per-capita values of the capital expenditures on libraries. It also makes for a much clearer explanation of the relationship between the two variables.

4.8. Summary and Conclusions

These are provided in Chapter 10, 10.2. conclusions 34 to 42.

Table 21. A Relative Frequency Distribution of Capital Expenditure per Capita on Libraries for 1969/70. compiled from data of 58 English counties, adjusted

Interval Class of Expenditure per Head of Population	Relative Frequency
0 and under 5p.	0.432
5p and under 10p	0.310
10p and under 15p	0.138
15p and under 20p	0.069
20p and over.	0.051
Total	1.000

Note
In this case, the modal class is '0 and under 5p, the median is 5.5., the mean is 7.5, and the standard deviation is 7.5. The highest value of the variable is 37p per head of population

Table 22. A Categorised Frequency Distribution of Capital Expenditure per Capita on English, and English and Welsh Counties' Libraries 1970/71

Interval Class Capital Outlay on Libraries per capita	English Counties		English & Welsh Counties	
	Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency
Under 5p	9	0.200	14	0.241
5p and under 10p	15	0.333	19	0.328
10p " " 15p	11	0.244	11	0.190
15p " " 20p	5	0.111	5	0.086
20p " " 25p	1	0.022	1	0.017
25p " " 30p	2	0.045	2	0.035
30p and over	2	0.045	6	0.103
Totals	45	1.000	58	1.000

Note
The modal class has now risen to '5p and under 10p', and the mean to 12p. This is not purely attributable to inflation but to capital expenditure programmes for 1970/71. Further, Welsh values fall into only three of the interval classes as explained in the text.

Table 23. Expected Interval Class Relative Frequencies for Capital Expenditure per Capita 1970/71 using the model

Class Interval	Value of r when λ = 1.6	Expected Relative Frequency for Class Interval
Under 5p.	0	0.2019
5p and under 10p	1	0.3230
10p " " 15p	2	0.2585
15p " " 20p	3	0.1378
20p " " 25p	4	0.0551
25p " " 30p	5	0.0177
30p and over	6 →∞	0.0060
Total		1.0000

Table 24. Some Examples of Statistical Measures for Capital Expenditure Categories per Capita 1970/71

Category of Capital Expenditure	Mean	Standard Deviation	Coefficient of Variation
Aggregate (i.e. all Services)	11.411	3.698	0.324
Education	5.635	1.650	0.293
Local Welfare	0.363	0.266	0.732
Highways	3.027	1.864	0.615
Libraries	0.110	0.091	0.827

Table 25. Categorised Frequency Distribution of Capital Expenditures per Capita for Small and Large Counties 1970/71

Class Interval	Small Counties (i.e. smaller than the mean = 530,000)	Large Counties (i.e. larger than the mean = 530,000)
Under 5p	7	3
5p and under 10p	10	4
10p " " 15p	6	5
15p " " 20p	3	2
20p " " 25p	0	1
25p " " 30p	2	1
30p and over	1	0
Total	29	16

Note

As explained in the text disproportionate stratification was necessary to ensure equal weight of aggregate populations.

Table 26. A Frequency Distribution of Capital Expenditure per Capita on English and Welsh County Libraries from Data for 1971/72

Class Interval Per Capita	Absolute Frequency	Relative Frequency
Under 5p	12	0.203
5p and under 10p	13	0.220
10p and under 15p	14	0.237
15p and under 20p	4	0.068
20p and under 25p	5	0.085
25p and under 30p	3	0.051
30p and over	8	0.136
Total	59	1.000

Note

The number 59 includes all published values, as in previous years, when one value was excluded from publication.

Table 27. A Correlation Matrix for some Categories of Capital Expenditure per Head 1971/72 showing that some minor categories (e.g. libraries, highways) are more sensitive to aggregate changes than major ones

Category	Aggregate	Education	Highways	Libraries
Aggregate	1.000			
Education	0.582	1.000		
Highways	0.865	0.138	1.000	
Libraries	0.506	0.048	0.592	1.000

Note

Education as an example of a major category is less sensitive to additional funds than the minor categories. See text.

Table 28. A Frequency Distribution of Capital Expenditure per Capita on English and Welsh County Libraries 1972/73

Class Interval	Absolute Frequency	Relative Frequency
Under 5p	8	0.13
5p and under 10p	11	0.19
10p " " 15p	6	0.10
15p " " 20p	7	0.12
20p " " 25p	7	0.12
25p " " 30p	4	0.07
30p " " 35p	3	0.05
35p " " 40p	3	0.05
40p " over	10	0.17
Total	59	1.00

Table 29 - Correlation Matrix - Absolute Capital Expenditure Variables from typical data through the period 1969/70 to 1973/74, using linear values

	Population	Aggregate Capital Expenditure	Capital Expenditure Libraries
Population	1.000		
Aggregate Capital Expenditure	0.946	1.000	
Capital Expenditure Libraries	0.704	0.780	1.000

Table 30 - Correlation Matrix - Absolute Capital Expenditure Variables from typical data through the period 1969/70 to 1973/74, using logarithms of values

	Population	Aggregate Capital Expenditure	Capital Expenditure Libraries
Population	1.000		
Aggregate Capital Expenditure	0.966	1.000	
Capital Expenditure Libraries	0.767	0.782	1.000

Table 31 - Unadjusted Correlation Coefficients between values of capital expenditure per capita on libraries, 44 English counties, 1969/70 to 1973/74

	1969/70	1970/71	1971/72	1972/73	1973/74
1969/70	1.000				
1970/71	0.393	1.000			
1971/72	0.157	0.023	1.000		
1972/73	0.163	-0.098	0.877	1.000	
1973/74	0.427	0.230	0.217	0.374	1.000

Table 32 - Adjusted Linear Correlation Coefficients between capital expenditures on libraries for 43 English Counties (excluding Rutland) 1969/70 to 1973/74

	1969/70	1970/71	1971/72	1972/73	1973/74
1969/70	1.000				
1970/71	0.396	1.000			
1971/72	0.374	0.550	1.000		
1972/73	0.307	0.199	0.531	1.000	
1973/74	0.448	0.344	0.451	0.580	1.000

Table 33. Some unadjusted non-linear correlation coefficients between values of capital expenditure per capita for contiguous pairs of years, using capital expenditure on libraries for 44 counties

Year X for values of capital expenditure on libraries per capita	Year Y for values of capital expenditure on libraries per capita	Correlation Coefficient log X, log Y	Correlation Coefficient $\frac{1}{X}$; $\frac{1}{Y}$
1969/70	1970/71	0.472	0.455
1970/71	1971/72	0.246	0.498
1971/72	1972/73	0.396	0.024
1972/73	1973/74	0.424	0.079

Note
The purpose of the table is to show that although non-linear correlation gives better coefficients for some years for the unadjusted set of counties in Table 31, because of its effect on extreme values, there is no evidence that it produces consistently better coefficients. The more simple expedient of using linear correlation and excluding the extremely atypical values for Rutland gave generally more consistent coefficients through the period.

Table 34. Mean Capital Expenditure per Capita - 44. Counties using 1971/72 mean (= £0.13) as the class interval boundary

Class	Mean 1969/70	Mean 1970/71	Mean 1971/72	Mean 1972/73
All Counties (£)	0.07	0.12	0.13	0.18
Counties below boundary	0.06	0.09	0.07	0.13
Counties above boundary	0.09	0.15	0.19	0.24

Table 35 Mean Capital Expenditure per Capita - 44 Counties using 1972/73 mean (= £0.18) as the class interval boundary

Class	Mean 1969/70	Mean 1970/71	Mean 1971/72	Mean 1972/73
All Counties (£)	0.07	0.12	0.13	0.18
Counties below boundary	0.07	0.11	0.10	0.09
Counties above boundary	0.08	0.12	0.14	0.31

Note. These means are calculated on an aggregate population basis, and are not therefore simply means of values of the variable as in chapter four.

Chapter Five - The Effect of Capital Expenditure per Capita on Changes in the Rate of Issues of Books per Capita

5.1. Introduction

The good inter-period correlation of capital expenditure per capita indicated by the correlation coefficients in the previous chapter has presented a problem. Revenue expenditure has usually very good inter-period correlation because of the historical nature of budget-determination. Past revenue expenditure is used to prepare estimates, and library authorities attempt to adhere to estimates. Thus stringent authorities are likely to be so for several years, and high spending authorities are also likely to remain 'high-spenders'. This inter-period consistency was explored in depth in the earlier thesis (6).

But capital expenditure should not, in general, be very consistent from one period to another, for each capital project is a 'one-off' expenditure, and if capital is spent constructing a library in a given area, it is unlikely to be spent in exactly the same area again for a large number of years.

Examination of the evidence in the previous chapter indicates that the good inter-period correlation between 1970/71 and 1973/74 results from:
(i) the particular circumstances of the period, in which some very long-term plans for large central libraries were initiated, but after which there was not the same kind of long large-project library planning, because of the effect of stringencies in local government expenditure; and
(ii) the effect of the extreme values of smaller counties on the correlation coefficient.

In answer to (i) it should be said that as the very nature of planning during the period 1970/71 to 1973/74 assists in the determination of the termini of the period, there is no need for us to isolate this factor in our study at this stage. Nor is the inter-period consistency so great that we need to assess the effect of (i) increases or (ii) decreases in capital expenditure (per head of population) on the issue statistic. Each capital expenditure is, in effect, an increase. It is an increase in the total stock of capital between year t and year t + 1. We are concerned mainly with buildings, and the 'depreciation' effect is not therefore likely to be highly significant over our period.

In answer to (ii) in a preceding paragraph, it is evident that because the previous chapter has cautioned against placing too much reliance on the correlation coefficient, because of the effect of the extreme values of small counties, we must assess whether this effect of small counties, even when Rutland and Welsh counties are excluded, has tended to make the inter-period correlation coefficients more apparent than real. We can do so by :
(i) a non-parametric study involving the means of counties in the two most correlated years 1971/72 and 1972/3, to assess whether there is significant difference in the capital expenditures of counties for other years when they are classified into small- or large-spenders using the 1971/72 and 1973/73 means; and
(ii) a particular study of the correlation coefficients of small counties whose capital expenditure values, as chapter 4 has indicated, tend to be more widely dispersed than large counties.

This re-examination of inter-period consistency of capital expenditure will comprise section 5.2 of this chapter.

The issue statistic poses greater problems. Although we could assume with respect to capital expenditure (per capita) that single values of capital expenditure per capita can be used for correlation with their effect on issues because, despite inter-period consistency, each amount of capital expenditure is, in effect, an increase in the total stock of capital, we cannot make such assumptions about the issue statistic.

It should be evident, at this stage, that the issue statistic is much more highly correlated (i.e. consistent) from one period to another. This is because of the indigenous (i.e. social and educational) characteristics of the populations of given localities. In other words, unless a library is destroyed by natural disaster or a population is inhibited from library attendance by an epidemic, a region whose issues per capita in year t are 17 is unlikely to be reduced to 9 issues per capita in year t + 1. This is not a theoretical assumption. Earlier empirical studies showed that in the case of London, the inter-period correlations of issues per capita approximated 0.8 and 0.9 for 32 observations.

Thus, the simple correlation between capital expenditure per capita and issues per capita will not prove an hypothesis that the former affects the latter. Instead, capital expenditure per capita must be correlated with changes (i) increases or (ii) decreases in issues per capita.

The effect of redistribution after the 1972 Act on the continuity of issues per capita also poses problems, that reduce our effective sample. A sample has to be chosen for which (i) there is known continuity throughout the period, or continuity can be obtained by adjustment where boundaries have been redrawn; and (ii) there is some comparability between the commencing and terminal mean values of the statistic issues per capita, despite the general increase of the mode and small increase of the mean for all counties during the period.

In Section 5.3. I propose to show how the four terminal years' statistics may be used to provide indices of change in the issue statistic during the period 1969/70 to 1975/76 and to show how these indices are correlated with each other, using the smaller but more reliable sample for the purpose of detailed study. These indices are then correlated with the statistics of capital expenditure per capita for each of the years and the effect (or likely effect) of capital expenditure per capita for any one year in changing the issue statistic (using the four indices) is studied. Because of the caution in our approach explained in chapter four, I apply the same criteria to a sub-sample of small counties with extreme values.

It is shown in section 5.3. that although indices I, J, K and L are highly correlated to each other as indices of change in the issue statistic between the two termini of our period, they are differently correlated with capital expenditure per capita for each of the years. Some significant correlation coefficients are then discussed and the chapter is concluded by providing, from specific primary data of some of the 'exceptional' counties, reasons why the discussion should, in future chapters, proceed from the 'general' to the 'particular' cases of the effect of capital expenditure on the issue statistic. These are, briefly, because of problems of:

(i) the disparity in the use of capital expenditure on large and small projects, and the effect of intra-county dispersion or concentration of capital expenditure on our results;

(ii) the effect of occasional disparity between published capital expenditure data and that obtained from primary sources;

(iii) the effect of 'peak' expenditure in one year (for any particular county) as distinguished from a general spread of expenditure;

(iv) the possible effect of sub-category differences in the use of capital funds (for example, building contrasted with site-acquisition costs); and

(v) the effect of the treatment of expenditure on mobile and on container libraries.

Thus the chapter will contain:

(i) a further discussion of inter-period consistency of capital expenditure and the limitation that it may impose on the use of untreated values of capital expenditure per capita;

(ii) a discussion of the need to convert values of issues per head of population to indices of change, and the reasons why they must receive such treatment for correlation purposes;

(iii) a discussion of the reliability of such indices, and of the correlation between capital expenditure and these indices using (a) all counties; and (b) small counties,

for reasons given earlier; and
(iv) a discussion, using primary data of particular counties as evidence, of the reason for the movement from general to particular cases, studying particularly the effect of intra-county concentration on large projects, differences between primary and published data; the effect of peak expenditure in one period, the effect of sub-category differences in the use of capital funds and the problem of the treatment of mobile and container libraries.

5.2. The Inter-Period Consistency of Capital Expenditures

Capital expenditure, as stated in 5.1., is 'once-for-all' in any particular locality. Unlike revenue expenditure or the issues of books from libraries there need not be high inter-period correlation of capital expenditure , except in respect of continuing long large projects, for there is an assumption that when a project has been completed, no further capital expenditure will be needed on that particular project for a very long time.

Despite this theoretical statement there is significant inter-period correlation, particularly between 1970/71 and 1973/74. This mainly results from long large projects initiated in 1970/71 when funds were available, and when capital expenditure on libraries was over-sensitive to increases in aggregate capital expenditure. When aggregate capital expenditure became less available two years later, library investment was over-sensitive to the effect of stringencies, and the period of apparently high inter-year correlation terminated.

The theoretical statement suggests that we should use actual values of the variable 'capital expenditure per capita' rather than indices of change in the values for the purpose of correlation with changes in the issue statistic, because each year's expenditure is, in effect, a once-for-all increase in the total capital stock. This position is confirmed if can be shown that:
(i) despite the effect of long large projects, the inter-period consistency is more apparent than real; and

(ii) there is no inter-period correlation between the terminal values of the variable (for example, between capital expenditure per capita in 1969/70 and 1973/74).

In chapter four, we showed that the data of small counties are more highly dispersed than those for all counties. If it can be shown that the correlation coefficients are affected by such extreme values, condition (i) above will be satisfied; and the actual inter-period consistency shown to be lower than apparent. But even if there is shown to be inter-period consistency using non-parametric methods, we shall have the benefit of isolating the counties with low expenditure from those with high expenditure, and the low coefficient between values of the variable for commencing and concluding years will, at least, indicate that the 'per capita' values of library investment should be employed (not changes, i.e. increases or decreases in capital expenditure) for correlation purposes.

Table 34 classifies counties into two classes, using the (90n) 1971/72 mean capital expenditure per capita £0.13 as a class boundary to distinguish counties with large per capita expenditure from those with small per capita expenditure. Table 35 uses the 1972/3 mean capital expenditure as a basis of classification into classes with large and small capital expenditures for that year. In each case the means of the classes so obtained were calculated and exhibited. The reason for the choice of 1971/72 and 1972/73 for this purpose is, of course, that these two years present the most significant correlation with each other when 44 values of the variable (i.e. all published English counties) are used. Many counties fell into the same classes in both periods, but the use of two years' statistics for comparison obviated the effect of random or stochastic disturbances in any particular year. As small counties are distributed in both classes (high and low spenders) the simple comparison of means will show whether the effect of small counties is significant.

(90n). To aid accessibility, these tables (34 and 35) appear at the end of the previous chapter, (page 199) as they are also relevant to the question of inter-period consistency raised there.

Further I must point out in clarification, that the means for all counties in Tables 34 and 35 are computed on an aggregate basis, and therefore differ from those of chapter four significantly. This is because those of chapter four were the simple means of all values of the variable (without weighting for population) for all the counties of England and Wales.

It can be seen that there is general association between the means of counties over the period. In other words, the set of counties whose values of capital expenditure were higher than the means for both 1971/72 and 1972/73 also had higher means of values of capital expenditure per head of population for all other years from 1969/70 to 1972/73. Projection into 1973/74 also showed it to be the case for that year. Thus, high spenders for 1971/72 and 1972/73 were high-spenders throughout the period and vice versa.

Further, in anticipation of 5.4 it can be said, at this stage, that those counties whose capital expenditures were consistently below the aggregate means in both 1971/72 and 1972/73 also experienced a decline in their mean value of issues of books per capita from 12.7 in 1970/71 to 11.92 in 1975/76. I mention this fact, at this stage, to indicate that even if linear association (i.e. correlation) is not established, there is still a case for believing that those counties whose capital expenditures per capita were consistently lower than the mean did experience a decrease in their issues of books per capita through the period. The association of consistent high spending with increases in issues per capita was not as noticeable because of the general increase in issues per capita through the period. In fact, among counties whose capital expenditures were below the mean for 1972/73 there was a correlation coefficient of 0.41 between capital expenditure per head, and the rate of change in issues. This coefficient is significant at the 5% level of significance. Further, 10 of the 16 counties whose issues declined over the period had aggregate capital expenditures per capita on libraries that were below the means in both 1971/72 and 1972/73. This result is significant using Fisher's test at the 5% level of significance . Thus a non-parametric association between low capital expenditure and a decline in the issue statistic can be postulated and pursued, even if linear correlation does not provide useful values.

We have thus shown that there is good inter-period association between capital expenditure on libraries irrespective of the effect of small counties on the correlation coefficient. As suggested earlier, we can now discuss whether, for small counties, the inter-period correlation coefficients of the variable capital expenditure per capita are higher than they are for all counties generally. In fact, they are not significantly higher. For the 13 smallest counties the correlation coefficient between 1970/71 and 1971/72 capital expenditures per capita values was 0.537, that between 1971/72 and 1972/73 values was 0.433 and that between 1972/73 and 1973/74 values was 0.670. These values are not significantly different from those of Tables 31 and 32 despite their having been calculated from a much smaller set of observations. Thus, though the extreme capital expenditure (per capita) values of small counties contributed to the correlation coefficients, there can now be no doubt, that despite the effect, there was a real consistency in spending patterns of counties over the period. This consistency simplifies our approach to the problem for we can question whether those counties that were high-spenders experienced increases in issues and low-spenders (throughout the period) experienced decreases in issues, but not before considering the effects of (i) an increase in spending, and (ii) a decrease in spending.

If capital expenditure were not 'once-for-all' in its effect we could seriously consider the effect of such increases and decreases, but, in fact, the period is, itself, atypical, and correlation of capital expenditure values for commencing and terminal years shows this to be the case. The correlation coefficients, using the group of 37 counties enumerated in the next section, for whom continuity can be studied, show this to be the case. That between values of capital expenditure per capita for 1969/70 and 1974/75 is -0.68; for 1970/71 and 1974/75 it is -0.26; and for 1970/71 and 1975/76 it is 0.152. Yet, for this particular set of counties even the correlation coefficients between capital expenditure per capita in 1969/70 and that of the four subsequent years are respectively 0.515 (1970/71); 0.436 (1971/72); 0.355 (1972/73) and 0.443 (1973/74).

Thus, the period itself stands out very clearly. There is such distinction between capital expenditure in this period and that in preceding years that we would not be justified (even ignoring the theoretical case that capital expenditure is a 'once-for-all' payment on a project) in simply attempting to correlate increases or decreases in capital expenditure with increases or decreases in the values of issues per capita. For not only is every item of capital expenditure an increase in capital stock available, but there is such poor correlation between capital expenditure values in this period and those in terminal and subsequent years , that we can for empirical reasons safely ignore any argument that only increases or decreases in capital expenditure should be used in correlation.

5.3. The Case for Using Indices of Change in the Variable, Issues per Capita as bases for correlation with investment

It was argued in Part I of the thesis, that library issues are an estimator of social income from libraries. If the relationship between issues and social income is linear then the case is that as income (issues) derives from existing capital stock, so additional income (i.e. an increase of issues) derives from capital expenditure, which is effectively, an increase during any year in the total stock of capital. Thus, capital expenditure (per capita), should be correlated with increases or decreases in issues per capita, not with issues (per head of population) untreated in this way.

This theoretical argument can be supported heavily with empirical data. Studies of the behaviour of the variable, issues per head of population, over the years 1965/66 to 1971/72 in the case of London in the previous thesis (6) and for all counties and other library authorities for the later period have shown that there is a very high inter-period correlation between issues per capita for any two proximate years. This is because of the effect of social, educational and other indigenous factors on the issue statistic of any given area, for example, Barnet and Camden in contrast with Newham and Islington in the case of London, and because of the effect of the existing stock of capital on existing issues. This inter-period autocorrelation of issues per head of population militates against the correlation between capital expenditure per capita and issues per capita. Instead, we should evidently proceed, using correlation coefficients assess the effect of capital expenditure (i) in each of the years and (ii) throughout the period, on increases or decreases (i.e. period changes) in issues per head of population.

When studying the issue statistic in chapter three, we selected two termini a quo (1969/70 and 1970/71) and two termini ad quem (1974/75 and 1975/76) for studying the issue statistic. This is because the use of any one year runs the danger of not obviating the effect of either stochastic or episodic disturbances on the issue statistics for any one year. We could compare the mean values for commencing years with the mean values of concluding years, and thus produce one index of general change in the issue statistic through the period. I shall propose this 'ideal' index of change later, but this would only give us one term of reference. For the present we can benefit from having data available for four years by compiling four indices of change over the period.

$$\text{(i) Index I} = \frac{\text{Issues per Head of Population 1974/75}}{\text{Issues per Head of Population 1969/70}}$$

$$\text{(ii) Index J} = \frac{\text{Issues per Head of Population 1974/75}}{\text{Issues per Head of Population 1970/71}}$$

$$\text{(iii) Index K} = \frac{\text{Issues per Head of Population 1975/76}}{\text{Issues per Head of Population 1969/70}}$$

$$\text{(iv) Index L} = \frac{\text{Issues per Head of Population 1975/76}}{\text{Issues per Head of Population 1970/71}}$$

The use of all four indices has the effect of ensuring that we make the best possible use of available data. Further, we can produce a correlation matrix indicating the extent to which these indices of change in the issue statistic are correlated to each other, and conversely, assess the effect of stochastic and episodic factors on the data for any one year.

The production of these indices poses the problem that county boundaries changed in the years following the 1972 Act and that issue statistics have to be completely recalculated for the counties to ensure comparability between commencing and terminal periods. There were 45 pre-redistribution counties but 39 counties after re-distribution. In some cases the study of the issue statistic on a 'continuous' basis is not possible; in a second set of counties pre-redistribution counties form a better base for the incorporation of data of associated authorities than post-redistribution counties; while for a third set of counties it is better to use post--redistribution counties and recalculate the issue statistic for the equivalent area before redistribution. Further, I wished to obtain a sample of counties whose mean issue statistic per capita had changed little through the period, despite the overall increase of both the mode and median rate of issues per capita between 1969/70 and 1975/76. This involved the exclusion of some extreme cases, but as many of these were Welsh authorities whose increases per capita had a marked effect on the overall unweighted statistic, it was not difficult to obtain a sample of 37 English counties with a slow-rising mean issue statistic, from which inter-period comparison could be made. The only disadvantage posed by the sample is that some authorities are pre-redistribution and other post

-redistribution. To give examples, for Hereford I used pre-redistribution data and extracted Worcestershire from the Hereford and Worcester data after the redistribution, making adjustments for non-county library authorities, while for North Yorkshire and Yorkshire(North Riding) the reverse was true. In most cases, pre-redistribution counties were used and post-redistribution counties' statistics were adjusted, but adjustments were made for non-county authorities, except where it was known that no substantial capital expenditure had been incurred in respect of the associated non-county library authority, or authorities. Thus, the sample of changes in the statistic issues per capita over the period is taken from disparate array of disproportionately sized authority areas, and the limitation in our analysis must be borne in mind.

Its justification is that:

(i) it ensures comparability despite the effects of the 1972 Act; and

(ii) it avoids cases of very large increases of issues per capita during the period, such that the highest increase of the mean is only 10% though one case Gloucestershire has a period increase of 46%, using index L. This, of course, has nothing that results from the aggregation of Cheltenham as may be evidenced by the fact that indices I and J give decreases of the variable for Gloucestershire.

Table 36 provides the sample values of indexed changes in the issue statistic using indices I,J,K and L, while Table 37 provides capital expenditure values expressed per head of population for 45 old counties. Some of the 45 values had to be excluded for the purpose of correlation, but it will now be apparent that the reason for adhering to old counties rather than new counties as the sample base (despite North Yorkshire) was that most of the <u>capital expenditure data</u> was expressed in terms of <u>old</u> counties.

We are now in a position to ask whether there is a good correlation between the indices of change in the issue rates, inter se. Table 38 exhibits the correlation matrix between the four indices. It can be seen, for example, that indices I and K are highly correlated with each other (0.767), but that there is almost zero correlation between indices I and L. All coefficients except that between indices I and L are significant. Thus, we should not use indices I or L in isolation, though any other combination is likely to provide us with a satisfactory picture of the trend through the period.

Having decided in the previous chapter that we should exclude consideration of the study of any (unlikely) effect of capital expenditure per capita in 1974/75 and 1975/76 on the changes in the rates of issues per capita, I, J, K, and L up to that year we can now retain values of the capital expenditure variables for the five years from 1969/70 to 1973/74 exhibited in Table 37, and calculate the coefficients between capital expenditure variables for each of the five years and each of the four indices of change in the issue statistic (issues per capita). The correlation matrix is presented in Table 39.

The actual correlation matrix presents a low set of values, despite attempts to achieve comparability in the selection of sample and in the adjustment of values to take boundary changes into account. The only correlation coefficient that is significant at the 1% level of significance is that between capital (0.588) expenditure per capita in 1969/70 and Index L, the index of change in the rate of issues per head of population between 1970/71 and 1975/76. This is instructive for it shows the earliest capital expenditures to have been consistently effective over the longest periods. But index L correlates at the 10% significance level with the capital expenditures for 1970/71 and for 1971/72, whereas no index produces comparable correlation coefficients, except that between index J, the increase in issues per capita between 1970/71 and 1974/75, and the capital expenditure for 1971/72, indicating that capital expenditure in the second year of a period may have a significant effect on the rate of change in the issue statistic during that period. Yet this conclusion is not well-founded, for if it were the case there would be significant correlation between capital expenditure during 1970/71 and index K, that of change in the issue statistic from 1969/70 to 1975/76. An examination of the table will indicate that this coefficient is -0.74, a near-zero correlation coefficient.

Thus, the results are disparate. Index I is very poorly correlated to capital expenditure 1970/71 such that

$$I = 0.981 - 0.386\ CE_{1970/71} + U_i\ ;$$

where CE_i is the capital expenditure in year i;
while index J is best explained by the regression equation:

$$J = 0.976 + 0.836\ CE_{1971/72} - 0.322\ CE_{1973/74} + U_j;$$

and index K is only explained in terms of the capital expenditure of 1969/70 such that:

$$K = 0.961 + 0.599\ CE_{1969/70} + U_k\ ;$$

while index L is best explained by the equation:

$$L = 1.037 + 1.837\ CE_{1969/70} - 0.389\ CE_{1973/74} + U_l.$$

None of these regression equations is intended to be strictly explanatory, but simply serve to show the relationship between capital expenditure and changes in the issue rates (when both variables are expressed per head of population).

It is particularly noticeable that for these four indices, the regression coefficients for the early years' capital expenditures are positive, and in the case of 1969/70 highly positive; while there are no regression coefficients in respect of capital expenditure for 1972/73 and the regression coefficients in respect of 1973/74 are both negative. There is thus an indication that the effect of capital expenditure in the earlier years of the period in changing the issue statistic is much greater than that of the capital expenditure of later years, though not much significance need attach to the fact that the regression coefficients in respect of capital expenditure for 1973/74 are both negative.

On a regression basis with the F-value of 2.6715 as the highest for entry, both regressors are admissible in the case of L, for they both provide regressors high enough for entry and the particular multiple regression equation given earlier:

$$L = 1.037 + 1.837CE_{1969/70} - 0.389\ CE_{1973/74} + U_1$$

does account for 45% of the variation after allowing for time-series effects and the probability of autocorrelation. Even if it is not particularly useful as an explanatory model, it serves, by identification of the value of U in each case, to isolate specific cases where observations differ particularly from regression estimates.

The main positive cases are those of Lincolnshire (Kesteven), Bedfordshire, Gloucestershire and Essex; while the main negative cases are Lincolnshire (Lindsey and Holland) and Cumbria and Nottinghamshire. This does not however mean that the former counties were 'good' and the latter counties 'bad' performers, for these regression errors are, it must be remembered, measured against capital expenditure of a single positive value at the beginning of the period and a single negative value at the end of it.

There is a valid reason for considering indices J and L in preference to I and K. It is that the issues for this sample in 1969/70 were atypically high, hence the peculiar mean ratios at the foot of Table 36. Although our sample was chosen to avoid extreme cases, the means for this set of counties in 1970/71 (11.562); 1974/75 (11.649) and 1975/76 (12.470); and the standard deviations for 1970/71 (1.760); 1974/75 (1.555) and 1975/76 (1.876) are closer than those of 1969/70 (mean = 12.135 and standard deviation 2.838) for this particular set of counties (though the general mean issues per capita were much lower in 1969/70).

Our use of the statistics of single years has helped to safeguard the study against the atypical nature of one year's statistics (in this case 1969/70), and we may simply use indices J and L as indices of the period without further question. But there is considerable variation between 1974/75 and 1975/76 issues per head, even though the means and dispersions for the issues per capita for these years are 'typical'. For example, if the regression equation is used:

$$\text{Issues}_{1975/76} = 4.506 + 0.682\ \text{Issues}_{1974/75}$$

where 'Issues_j' means 'issues per head of population in year j' there are cases that cannot be fitted, such as the exceptional increases in the issues of Bedfordshire (9.9 to 16.9) and Gloucestershire (11.9 to 18.2) per head of population. Thus, there is some 'randomness' about single years' values generally and for this reason it is instructive to apply, for the purpose of further comparison a fifth index M, where

$$M = \frac{\text{Mean of Issues per Head of Population 1974/75 \& 1975/76}}{\text{Mean of Issues per Head of Population 1969/70 \& 1970/71}}$$

The mean value of M was 1.02 (because of the atypical effect of 1969/70 issue values) but its dispersion was low, 0.14, and it did not produce significantly greater correlation coefficients with any of the annual capital expenditure variables for the years 1969/70 to 1973/74, though it correlated well with indices I (0.856); J (0.474) and K (0.638) but not L (0.010). Because of its higher correlation with indices I and K than with J and L it was concluded that index M must have been affected by the atypical nature of the issues per capita of 1969/70 for these particular counties, and therefore abandoned as a useful index.

At this stage it should be stated that a study of the small counties was undertaken using indices I,J,K,L and M and capital expenditures from 1969/70 to 1973/74 to assess whether the coefficients were affected by the more extreme values of capital expenditure for small counties. Again, indices J and L produced the highest coefficients.

The results and conclusion of 5.3 can now be summarised. It was argued that although untreated values of capital expenditure per capita should be used for the purpose of correlation, issues should be treated for correlation purposes, for they are highly correlated from one period to another, and there is need to assess the effect of capital expenditure on changes in the issue statistic Four indices I,J,K and L were proposed using the issue statistics for the two concluding and two terminal years. Except for I and L these indices were significantly correlated to each other, but when the indices were correlated with capital expenditure values, J and L, and particularly L were seen to have useful results. I and K could suffer from the atypical nature of the issue statistic for the particular set of counties that was chosen,(because of difficulties of continuity resulting from boundary changes) for 1969/70. The matrix indicates that 1969/70 is the most 'effective' year for capital expenditure and that index L, measuring the change from 1970/71 to 1975/76 in the issue statistic is the most 'effective' index.

But such a consideration does not take into account:
(i) the disparity in the use of capital funds by any one county library authority, distinguishing between the concentration of capital expenditure for one year on a large project, and the dispersion of capital expenditure for that year on a number of small projects;
(ii) the allied question whether 1969/70 was an 'effective' year because it witnessed a large number of smaller projects while the years in the sequence 1970/71 to 1972/23 appear less effective, because they are years of longer larger projects, evidenced by the strong inter-period correlation of capital expenditure on chapter four;
(iii) the effect of 'peak' expenditure for a given county in one year, distinguished from the large spread of smaller expenditure by others (which would not affect the correlation matrix) because of small annual values;
(iv) the disparity between primary and secondary data;
(v) the effect of sub-category differences in the use of capital expenditure (buildings, furniture and site-costs); and
(vi) the effect of the treatment of mobile library acquisition costs.

5.4 Some Limitations of our Analysis.

The previous sections have presented two possible hypotheses (i) that capital expenditure in 1969/70 had significant effect on the increase of issues per head of population between 1970/71 and 1975/76 measured by index L, (either because 1969/70 is the first year of the sequence and has a longer 'lag' or because it is, in respect of capital expenditure, typical of the first three years of the sequence); or (ii) that the input of capital expenditure generally between 1969/70 and 1973/74 had an effect in increasing issues between 1969/70 and 1975/76. Hypothesis (i) was supported by a regression model, and hypothesis (ii) can generally evidenced by counting the counties with significant mean inputs of capital expenditure shown in Table 37, and comparing these with increases of issues, and alternatively comparing the frequency of counties with significantly low mean inputs with decreases in issues.

But both approaches to the problem are generalizations, and it is now necessary to study the limitations of our analysis, particularly by studying exceptions to these generalizations. I have already stated that Lincolnshire (Kesteven), Bedfordshire and Gloucestershire are positive performance exceptions using the error components of the regression equation for index L, and that Lincolnshire (Lindsey and Holland), Cumbria and Nottinghamshire are the main negative performance exceptions, using error components (i.e. differences between regression estimates and observations) with that equation.

We may easily obtain the exceptions to hypothesis (ii) by reference to Tables 37 and 38. I have not adjusted for inflation in calculating the mean (per capita) for the five years, so that this table may be easily checked. As the mean is the 'typical' value for the middle year, it will approximate the adjusted mean except where expenditures are highly skewed over the five years, even though the inter-year inflation indices are different, particularly in concluding years.

If one uses the upper quartile (0.15 and over) as an indicator of significantly high capital expenditure, then Lincolnshire (Kesteven), West Sussex, Northumberland, Buckingham, Derby, Durham and Hampshire may be regarded as conforming to hypothesis (ii) while Rutland, Westmorland, and Leicestershire may be regarded as particular exceptions. Conversely if the lower quartile (0.8 and under) is an indicator of 'significantly' low capital expenditure over the period, then Lincolnshire (Holland), Hereford, Cambridge and Ely, East Sussex and Stafford can be regarded as conforming to the rule, while Isle of Wight, Oxford, Somerset, Essex and Kent are exceptions, i.e. good increases in issues despite low mean inter-period capital expenditure.
It is already apparent that some cases are self-answering for they conform to one hypothesis but appear as exceptions in the other. They are cases where 'peaked' investment in a year other than 1969/70 answers a problem imposed simply by considering that year. Let us then consider some limitations of our analysis, using exceptions to hypotheses (i) and (ii) as a basis for illustration, thus defining particular parameters that impose constraints on our generalised models.

5.4(i). Dispersion and Concentration of Projects.

Cumbria appears as an exception to both hypotheses, as Cumbria to (i) and as Westmorland to (ii). It must be stressed that neither Cumberland nor Westmorland is a low issue-performer, using the absolutes and per-capita statistics. The apparent inter-period decline results from exceptionally high rates of issues per capita at the beginning of the period. Though the region does appear as an exception using rule (i), the case is best examined by reference to rule (ii), for the means are determined by 'peak' investments late in the period (1972/73), but are affected by local concentration of capital also. Information kindly forwarded by Mr. J.S.Smith, F.L.A., the Cumbria Librarian (90)

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90. Letter dated 25 February 1976, PTG/MEB

shows that although the major pending project for Westmorland was Ambleside, proposed at £51,520, in 1971, most of the capital expenditure was late in the period and included not only Ambleside (£45,000), but the restructuring of Windermere library (£15,000). Yet for the Westmorland portion of Cumbria the only apparent decline is that measured by index I which has been regarded as less reliable because of the atypical nature of 1969/70 issue statistics. Using the more reliable index L, there is a 10% increase in the issue performance. The Cumberland portion of Cumbria experienced implementation of a number of projects late in the period, but there was some geographical concentration, Barrow (£20,000); Workington (£22,500); Cockermouth (£17,500); Seaton (£23,800); Keswick (£47,300); Longtown (£34,500); Wigton (£39,600); Frizington (£13,000) and extension to Gosforth (£1,500). It can be seen from the list of names that several are concentrated in the centre of Cumbria near the Westmorland border. Thus:

(i) the apparent decline by one index (I) for both old counties, results from exceptionally high values in 1969/70;

(ii) index L shows positive increases for both components of present Cumbria;

(iii) early payments in the period were concentrated geographically, thus the late indices show the best results;

(iv) later projects were more geographically dispersed, but because the mean was affected by a 'peak' expenditure in 1972/73 issues are better shown to have increased by the latest index L, than by the earlier index I.

The question of 'peak' investment will be considered later, but the suggestion that the apparent decline for both 'old counties' resulted from 'concentration' in early years can now be pursued with respect to the performance of Wiltshire. This is not a listed exception, for though all indices I,J,K and L are exceptionally high, the mean capital expenditure was near the upper quartile. Details of capital costs were supplied by the Wiltshire County librarian, Mr. F. Hallworth (91), which indicated (i) that a number of projects for development of new libraries had been partly met from revenue transfers; but particularly (ii) that there were a very large number of small projects in early years of our period. There were a dozen listed projects in estimates for 1969/70, including projects for construction and adaptations in Amesbury, Malmesbury, Mere, Purton and Estbury. In some of these, peak project expenditures had already been made, (91a) and projects were nearing completion, hence the effects of such expenditure could be expected immediately. Similarly, schemes at Box, Durrington, Devizes and Highworth neared completion in 1970/71 leaving little to be financed from later years.

The success is due to the large number of geographically dispersed small projects completed early in the period. The only central project concerned construction of the new regional headquarters at Chippenham. It was originally proposed that the 1970/71 estimate (£55,500) should be met by £30,000 in 1970/71 leaving £25,500, but the total had to be revised to £72,000 in 1971/72 and £87,500 in later years. Yet the main impact was borne after our period, which benefit~~t~~ed by early dispersion of small projects. There were no new projects except Wroughton of which only £10,000 was borne prior to 1973/74 and £15,000 in 1973/74. Thus, though Wiltshire was not an exception to either rule (i) and (ii) it has to be noted as evidence for the dispersion argument, because of its very high absolute values of issues per capita even though its mean capital expenditure was below the upper quartile for all years.

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91. Letter from librarian, May 1976.

91a. Throughout this discussion, the 'peak' year is that which bears the largest share of capital expenditure (either absolutely or per head of population) on any one capital project.

A third positive argument for the 'geographical dispersion' factor may be evidenced from the values of Cornwall. Again, Cornwall is not listed as an exception to hypotheses (i) and (ii), but like Wiltshire has significantly high issue increases measured by indices J and L, the more 'reliable' indices. The apparent capital expenditure is small in comparison to performance, for Cornwall ranks near the median for 'mean' values over the period. But this is because of the 'spread' of projects and because of early rather than late spending. For example, to use values provided by the Cornwall librarian in 1976, the St. Just new library (£18,400) was opened in late 1970 and the Fowey conversion (£17,364) took place at that time. In 1971 a new library was opened at Launceston costing £33,485, including £2,000 paid from revenue, but the bulk of investment had been incurred in 1968/69. Even for late projects, e.g. Callington (£31,682 in 1971/72); St. Austell (£26,500 in 1972/73) and Hayle (£46,000 in 1973/74), libraries were opened within 18 months of expenditure impact, so that the benefit apparent in increased issues was immediately evidenced. Thus high geographical dispersion of small projects and early completion of projects during the period provided both Cornwall and Wiltshire with good absolute changes in the issue statistic. There are other reasons, associated with mobile libraries, which will be recounted later.

A fourth case provides a negative argument for concentration. Although the issue rates for Rutland are not provided, the case of Rutland is the highest of all mean capital expenditures per head of population, and the rise in the issue statistic during the period is not comparable with that of either Cornwall or Wiltshire. This is because all the sums involved reflect the expenditure of £56,000 (92) and fees in an area that serviced 34,000 people, and for which some of the expenditure has to be assigned to 'Headquarters'. A fifth case, involving

92. The Library Association: New Library Buildings 1974.

the Isle of Wight, indicates how concentration could have affected the value if it had occurred. The Isle of Wight has been listed earlier as a case where an increase of per capita issues was achieved despite low mean capital expenditure. In fact the mean was itself influenced by a 'peak' in 1972/73 reflecting the capital 'site' cost of Newport Library, of which later expenditure was incurred after our period. The main impact will (91b) appear in 1979/80 and 1980/81 so that a highly concentrated project in a small area has been effectively 'phased' out of our period by local government stringencies. Thus, Isle of Wight, unlike Rutland, did not suffer from the effect of a highly concentrated, central-type project during the period, and all capital expenditure (except the £20,000 site cost of Newport library) was relevant to the period, thus affecting the issue statistic more than was apparent.

5.4(ii). The Effect of 1969/70 expenditures.

Our consideration of some exceptions to hypotheses (i) and (ii) has provided other limitations of analysis. It is already apparent that exceptions to (i) are not necessarily exceptions to (ii), and we can deal with residual exceptions to (i) and at the same time ask whether 1969/70 was an effective year because (a) it was the commencing year; or (b) it was correlated with other commencing years; or (c) it witnessed a larger number of small projects, as against the longer larger projects of the later period.

Lincolnshire (Kesteven) is a self-adjusting exception, though it is high-performer using (i) and (ii), for its mean capital expenditure value is affected by late expenditure, and provides an answer to hypothesis (i). The exceptional increase in issues may be attributed to mobile library usage, but at least indicates that for this exception 1969/70 expenditure is not 'typical' of the period. Bedfordshire and Gloucestershire are the remaining positive 'exceptions' to (i). For Bedford the year 1969/70 is clearly atypical, and Gloucestershire appears as an exceptional case also under (ii). I have already dealt with Cumbria and Lincolnshire (Lindsey and

(91b). Effectively, the phasing of this project was postponed after the site was acquired, because of capital stringencies.

Holland) as exceptions to (i) and (ii), and Nottinghamshire is a case of the effect of late expenditure, as I shall show in the next subsection.

These few exceptions to hypothesis (i), some of which are subsumed as exceptions to hypothesis (ii), illustrate that 1969/70 capital expenditure was effective because there were less 'lags' and 'uncompleted' project effects on the period for that year, and because 1969/70 expenditure was typical of the early years of our period. But we have not answered the likelihood that it may also have been effective because of its dispersed nature. Central libraries were completed in 1969/70 and there was some expenditure on others completed later, but the largest expenditures on West Norwood (£300,000) and Thurrock (£520,000) were outside the areas of our sample. Most of the expenditure on Gloucester Central Library (£132,000) was expended earlier, and the values of capital expenditure per capita for 1969/70 in Table 38 only reflect those for two libraries costing over £100,000. The mean cost per project for that year was low, and the mode approximately £20,000. Inflation had not, of (91c) course, yet made its impact on capital costs, but from a series of 40 projects obtained from the county estimates and other data for that year it was evident that the capital expenditures (per capita) in the Table for 1969/70 are highly dispersed on small projects in contrast to the large expenditures afterwards on Central Libraries of which 12 were completed before 1972, another 12 before 1974 and many of which were postponed, like that of Newport (Isle of Wight) and Derbyshire, after initial partial expenditures.

In conclusion of this subsection, it is seen that:

(i) the effectiveness of 1969/70 in comparison with later capital expenditure values, results from the 'lag' effect of later projects; and that

(ii) 1969/70 capital expenditure is also effective because it was highly dispersed on small projects, in contrast to longer, larger, later projects of a Central Library and 'Headquarters' description.

(91c). In the general sense, of course, inflation did so throughout the period. Here, I confine the term to the violent inflation of the early '70s.

Conclusion (ii) of 5.4.(ii) can thus be offered as auxilliary proof of 5.4(i) that the dispersion of capital expenditure on projects on small projects can render it more effective than the concentration of capital expenditure on larger, central projects with 'headquarters' components.

5.4(iii). The effect of inter-period distribution

We have already cited cases where the inter-period distribution affected the issue statistic. Cumbria appeared to be an exception to the regression equation for Index L, but was affected by the very high issue values for 1969/70 and by the late impact of late capital expenditure, evidenced by the fact that indices J and L give favourable results for Westmorland particularly. This late spending began to be wholly effective in 1975/76. Wiltshire's high increase in issues resulted from a large number of small projects early in the period, and the same may be said in respect of Cornwall. In the case of Rutland, the effect of 'peak' expenditure in two years was to produce the largest overall mean, but was concentrated expenditure on a Central project and the result was not seen in the period, while the 'peak' capital expenditure for the Isle of Wight related to site acquisition costs in respect of a project that has not been completed at the time of writing.

But these are only a few cases. We have exhausted the major exceptions to (i), but those to (ii) provide useful additional evidence of the effect of early 'peak' expenditure on issues, or of later 'peak' expenditure on the mean, thus tending to exaggerate the apparent exception to (ii). In the introduction to 5.4. we isolated the mean 'conformers' as Lincolnshire (Kesteven), West Sussex, Northumberland, Buckingham, Derby, Durham and Hampshire. These need no attention for they conform to rule (ii), and Lincolnshire - Kesteven's exceptional performance provides an answer to the apparent exception it creates to rule (i), that expenditure was peaked and came later in the period. The exceptions need attention,however. They are cases where significantly high expenditure appeared to produce no significant increase in issues. We have already examined Rutland and Westmorland, but not Leicestershire. I shall be tabulating the exact statistics for Leicestershire later as an illustration of disparity between primary and secondary data, but an examination of my own 'primary' computation based on statistics obtained from the County Librarian indicates the 'peak' year to be 1973/74, the last year of our period. Thus, Leicestershire was an exception to the hypothesis (ii) that 'mean' capital expenditure for the period effects a positive change in issues, because peak expenditure came late enough to be barely in our period.

Now let us examine negative cases. Lincolnshire (Lindsey and Holland) conforms to hypothesis (ii) though it was an apparent exception to hypothesis (i). It is clear that the reason why its being an exception to hypothesis (i) is answered by hypothesis (ii) is that end-of-period 'peak' investment distorted the result. But the decrease of indices generally for this county does not stem from lack of investment but from the very high initial issue statistic, because of mobile library activity before our period began. The 1969/70 issues per capita for Lincolnshire (Lindsey and Holland) were very high, and a decrease was almost inevitable in the absence of exceptionally large capital input. This was peaked in 1972/73, and no effect was apparent because no overall effect stemmed from this investment, though the Horncastle branch library project had significant local results as we shall examine later.

We need not deal in detail with the other main 'conformers' to the rule that a small capital expenditure effects low changes (e.g. decreases) in issues, but the exceptions must be considered carefully. We have dealt with Isle of Wight. Oxford, Kent and Essex have the advantage of a very large number of pre-existing branch libraries, and Essex also gained from the completion of Thurrock library. Of the absolute cases, i.e. those that were not particular exceptions to either (i) or (ii) but had significantly high increases of issues in the period, we have dealt with

Cornwall but not Gloucester. The case of Gloucester is less certain for the indices show some wide dispersion of performance, but the completion of the New Central Library at the beginning of the period had an impact on the initial issues such as to make this possible, and in this case the peak expenditure pre-dated our period by one year.

We can thus conclude that:

(i) changes in issues are affected both by 1969/70 values of capital expenditure, and by 'mean inter-period' values, but are unaffected by mean values when they incorporate 'peak' late expenditures comprising expenditure on uncompleted projects; and

(ii) there is some distortion (as in Cumbria and Lincolnshire (Lindsey and Holland) because of a pre-existent 'peak' in issues) where 'peak' capital expenditure does not become effective until late in our period.

5.4(iv). Disparities between Primary and Secondary Data

The values given in Table 37 are taken from Capital Expenditure Statistics produced annually by the Society of County Treasurers. Many of the values were adjusted later from primary sources because of 'rounding up' or 'rounding down' problems. The values are expressed in pence per head of population, and the need for accuracy in other categories of capital expenditure, and the requirement that such publications should 'balance' indicates that there must occasionally be rounding up or rounding down. Thus, I carried out checks on the values provided, and made adjustments to the regression variables where necessary. I provide in Table 40 an analysis and comparison between values provided by the Leicestershire County Librarian and those obtained from respective relevant issues of Capital Expenditure Statistics. The differences are not entirely the result of 'rounding up' differences. They are partly attributable to the increase in the population size of the administrative county (i) in 1969/70 from 350,000 to 469,050 because of the inclusion of the administrative responsibilities of some borough libraries and (ii) in 1975/76 from 500,000 to 829,800 because of lagged effects of the 1972 Act. It can be seen from the table that the degreee of approximation is good, that the Leicestershire problem does, as 5.4(iii) suggests, result mainly from 'peak' expenditure late in the period, and it is equally probable that the late 'peak' expenditure will have its reward in issue increases at some future time.

5.4(v). Subcategory classification of capital expenditure

The hypothesis that capital inputs result in an increase in the effective 'social income' of a library registered by its issue-outputs, is limited also because of the composition of capital expenditure. Table 40 has already shown the difference between expenditures on buildings, sites and furniture and equipment in one county over a period. I shall be omitting most of my work on intra-capital categories in this thesis because of lack of space, and because expenditure on buildings tends to correlate significantly with total capital costs. But some discussion is needed. We already saw that £20,000 was spent acquiring a site at Newport, Isle of Wight with delay in construction and no obvious effect in the period. In some cases a temporary building can be effective at much reduced cost. Further, as 5.4(vi) will show, mobile costs are, in theory (91d) capital, yet most counties fund them from revenue, and they have no effect on the published Capital Expenditure Statistics at all.

Before discussing mobile costs, let us consider a highly important example of the 'Giffen' effect on buildings with (91e) apparently good results. The 1970/71 estimates of capital expenditure for Surrey contained three major projects for libraries at Oxted, Redhill and Woking. Oxted was estimated to cost £70,756 but was completed and opened in September 1972 costing £84,375 excluding architects' and other fees. Site costs and furniture together amount for 10% of its cost, and a major proportion of the 1970/71 and 1971/72 expenditures per capita of 10p per head of population would

(91d). By 'mobile costs', I mean 'costs of mobile libraries' in this chapter and chapter seven.

(91e). The 'Giffen effect' here is not exactly analogous to that in commodity buying, but there is a similarity, that will be explained later.

have been spent on it, for the population of Surrey was 835,190, thus making Oxted over 10p per capita relating to a total of 20p per capita in the two years. This is yet another case of project concentration similar to 5.4(i) for although this library serves only 8,600 registered readers, its annual issue statistics within two years of construction were 253,000, which can be converted using the criteria of chapter 1 to a 'social benefit' of about £100,000. This is effectively a gross return, but when marginal costs are offset, i.e. the administrative costs of 2 librarians and $5\frac{1}{2}$ assistants, it can still be estimated as having a 'net' social benefit of £50,000 per annum, -and even if no account is taken of its meeting room and tea room facilities, it produces a net return of over 50%, yet its effect appears minimal in this large county, because the expenditure is concentrated. (5.4(i)). The effect of this outstanding project with good results was that the Redhill project (originally estimated in 1971 at £70,000) was changed in nature to a temporary library consisting of two linked demountable huts. The cost of buildings and fittings was only £8,000 but the library provides for 7,700 readers and the annual rate per member, 29, is lower than Oxted. (91f). It provides no fringe benefits, but even if the lower rate for mobile libraries is used for conversion into social income equivalents, though the annual issues are 210,000 even incremental issues(37,000)produced by the library provide a return on investment of several 100% when converted into social benefits. Thus, building costs were minimal but benefit was maximal. The third project that appeared in 1970/71 estimates was Woking at £168,000. but it was not completed until 7 April 1975 when it cost £380,000 for site, buildings and fittings and only £8,000 for furniture. It has no effect within the period, but one immediately afterwards for the issues of Surrey rose by 8% immediately after its construction from 11,976926 in 1974/75 to 12,777,180 in 1975/76. This increase of 800,254 justifies the investment for there is a 'gross'

(91f). That is, 29 books borrowed per member per annum.

equivalent over £320,000 using our conversion rate, and a net 'return' of over 50%, and other additional 'benefits' such as two gramophone listening booths, six study carrels and other features. But if one expresses in rates rather than in absolute amounts, it is evident that the temporary library at Redhill provided a much greater and more immediate return on investment, though it effectively cost less than the furniture at Woking. The Oxted-Redhill dichotomy in Surrey has an equivalent in Hertfordshire, as we shall see in chapter 6, where again two projects were budgeted almost equally, but overspending on a preferred project led to underspending on one of slightly less priority. The case is not exactly parallel to that of Giffen goods in elementary economics, but illustrates that even in library investment, which is itself oversensitive to capital increases and decreases, there is a 'passing-on' effect in which lower priority projects are even more highly-geared to increases, and particularly oversensitive to decreases of funds. The concentration at Woking accounts mainly for the amounts of 16p and 22p attributed to Surrey respectively in the years 1972/73 and 1973/74, and is therefore a 'peaked' terminal expenditure spent mainly on building costs, but having an immediate 'absolute' effect in increasing issues, though this is not reflected so easily and obviously in an increase of the rate per capita between 1974/75 and 1975/76 because Surrey is such a large county.

The publication, New Library Buildings 1974 (92)is not complete for our purpose because it does not include details of reconstructions and extensions, but only new architect -designed buildings. Further, it provides sub-categories of library costs, but not the phased spread of the costs of each project over the years of construction. Yet, the sample of (i) central libraries and (ii) branch libraries for which it provides details of the late years of our period, is sufficient to provide information about (i) the subcategories of expenditure on central libraries and branch libraries and (ii) the inter-category correlation coefficients for central and branch libraries.

Table 41 is analysis of the means of site, buildings and furniture costs based on the 12 central libraries for the period 1972-74. It does not differ much from the sample of central libraries in the period 1970-72, except that furniture costs are relatively lower, nor does this table of contemporary inter-library means and relative costs differ from Table 40, which provides the subcategories' costs for Leicestershire over a prolonged period.

A study of both tables serves to show that:
(i) the proportion of cost expended on buildings and furniture is less dispersed than that on site-acquisition, probably because some sites are charged to other capital categories and others are 'free', the reconstruction or rebuilding taking place on the site of an older library;
(ii) the relative cost of furniture declines over a period in comparison with site and building cost;
(iii) approximately 80% of capital costs of library construction are spent on buildings, and these therefore merit attention, rather than site costs which are highly variable, and for which no workable hypothesis can be constructed because of regional variations in cost, and inter-authority differences in their treatment.

Table 41 presents for the 12 buildings a correlation matrix for the 12 central libraries. The sample number (i.e. size) is low so that many of the coefficients are not highly significant. Aggregate library cost does not correlate very significantly with population size (0.735) and though this is partly because of the effect of site costs' variability (particularly in London), the coefficient between building cost and population size is not significantly higher (0.745), though the poor (zero) correlation between site cost and population size shows that site cost is not a useful object of analysis because of its high variability. Further, because building cost is (i) a high relative proportion of aggregate library cost; and (ii) highly correlated to it ($r = 0.988$), we can generalise the effect of capital investment on issues per capita, simply by examining the nature of building costs, and merely refer to site and furniture and equipment costs when these are exceptional. If the sample is extended to include all non-academic libraries presented in the 1974 publication (92) the relevant means are as shown in Table 42, and their correlation that depicted by Table 43. In this case we should expect high correlation coefficients between all the variables because all should be related to population size, and the sample contains projects which differ in aggregate cost from £9,000 to £940,000. Yet the correlation coefficients are not as high as one would expect, though building cost correlates significantly ($r = 0.991$) with aggregate library cost and with population ($r = 0.831$), but aggregate cost correlates less with population ($r = 0.829$). The result of this study is that we can generalise by using building costs in the following chapter. If we again refer to Table 40, giving typical inter-category composition for Leicestershire, the mean capital expenditure for the seven-year period is £115,008, the standard deviation £97,147, giving a coefficient of variation of 0.84, but with much higher coefficients of variation again for site-costs. Here, again the greatest proportion of capital expenditure was on buildings (84%), and there was a correlation coefficient (7 observations) of 0.983 between aggregate library cost and cost of buildings while that between aggregate cost and furniture was only 0.539, and that between aggregate library cost and site-acquisition cost was only 0.653, despite the probable similar treatment of cost of acquiring site, because we are using the inter-year data of one authority. For Leicestershire the appropriate regression equation is:

$$Y = 8328.6 + 1.19X + U$$

where:

Y = aggregate capital cost on libraries;

X is the capital expenditure on library buildings; and

U is a random variable.

Thus, in section 5.4(v) :

(i) an intra-period study of inter-library (i.e. inter authority) observations (1972 - 1974); and

(ii) an intra-authority study of inter-period (i.e. 7 year) observations;

have shown us that we may safely use a generalised model with building costs for the purpose of individual project analysis, because
(i) building cost forms a high relative proportion of aggregate library cost (80% - 84%); and
(ii) building cost is very significantly correlated with aggregate cost (0.983 → 0.988) even in the case of high cost central library projects where one would expect site costs in parts of England and Wales to vary considerably.

5.4(vi) The effect of Mobile Libraries.

Expenditure on mobile libraries is expenditure effectively in respect of (i) vehicles; and (ii) library equipment. Both commercial accounting practice and general accounting theory would unhesitatingly accept the premise that mobile libraries constitute capital investment. In fact, such libraries (as we shall see in chapter 7) form a large proportion of the effective capital of an authority, making a very high impact during the early years of a mobile library service because of novelty, but tailing to a 'normal' effect later. I do not wish to prove this premise at this stage, for it is the task of chapter 7. In this subsection it is necessary to illustrate, with evidence, that mobile libraries form a limitation to the 'capital expenditure statistics' based analysis of this chapter.

In fact, mobile libraries are mostly funded from a mobile library renewals fund which is serviced from revenue, and even when the acquisitions are originally treated as capital, inter-authority treatment is disparate. This forms an interesting case. The very high issues of Lincolnshire (Lindsey and Holland) in 1969/70 were partly attributable to the effect of mobile libraries, and it may also be illustrated that Cornwall, whose issues experienced high absolute increases per capita (absolute, in this case meaning unrelated to capital expenditure under either hypothesis (i) or (ii)), did so because of the proliferation of mobile libraries during the period. In this case mobile library acquisition expenditure was met from a vehicle renewals fund; to which annual contributions were made from revenue, and not only was £32,000 invested in mobile libraries over the five years, but two container libraries costing respectively £9,191 and £3,450 were acquired (the first cost inclusive of a tractor). Interestingly, Cornwall's success is not only attributable to making capital expenditures on mobile libraries under the heading of 'revenue', nor is it only attributable to small project proliferation, but it is a case of exception to the guideline of 5.4(v) where many libraries were built on sites funded from capital expenditure purchased by the education committee. Thus, in Cornwall, inter alia, mobile library and container library acquisition and 'free' (to library committee) sites indicate that real capital investment was greater than apparent.

5.5 Summary and Conclusions

These are provided in Chapter 10, 10.2. conclusions 43 to 54.

Table 36 - Four indices of changes in the issue statistic
Table of Changes in the Issue Statistic for 37 English counties over the period from 1969/70 to 1975/76

County	Indexed Changes in the Issue Statistic			
	1974/75 / 1969/70 = I	1974/75 / 1970/71 = J	1975/76 / 1969/70 = K	1975/76 / 1970/71 = L
Westmorland	0.94	1.06	1.04	1.10
Lincs. Lindsey & Holland	0.71	0.67	1.02	0.72
Isle of Wight	1.10	1.03	1.00	0.97
Hereford	0.84	0.81	0.88	0.85
Lincs. Kesteven	1.20	1.18	1.28	1.27
West Suffolk	0.97	0.94	1.06	1.09
Cumberland	0.80	1.08	0.71	1.07
Oxfordshire	1.11	1.05	1.19	1.12
Bedfordshire	0.67	1.03	1.15	1.76
Cambridgeshire	0.93	0.90	0.85	0.82
Yorks (N.R.)	1.13	1.08	1.22	1.16
Salop	1.01	0.95	1.06	1.01
Northampton	1.07	1.02	1.13	1.08
Dorset	0.85	1.06	0.88	1.10
Cornwall	0.90	1.13	0.95	1.19
East Sussex	0.83	0.92	0.78	0.84
Devon	0.93	1.06	0.93	1.06
Leicestershire	0.98	0.91	1.00	1.01
West Sussex	1.23	1.23	1.32	1.32
Norfolk	0.70	0.95	0.76	1.04
Berkshire	0.80	1.13	0.82	1.17
Wiltshire	1.26	1.14	1.37	1.25
Northumberland	1.33	1.24	1.14	1.06
Gloucestershire	0.76	0.95	1.17	1.46
Buckinghamshire	1.03	1.03	1.01	1.01
Somerset	0.99	1.04	1.05	1.11
Nottinghamshire	0.85	0.87	0.91	0.87
Derby	1.00	0.94	1.08	1.03
Staffordshire	0.55	0.94	0.62	1.05
Durham	0.83	1.02	1.09	1.34
Hertfordshire	0.68	0.98	0.68	0.98
Surrey	1.04	1.00	1.13	1.08
Hampshire	1.05	1.01	1.05	1.02
Cheshire	0.71	0.80	0.77	1.09
Essex	0.96	1.28	1.00	1.28
Kent	1.05	0.99	1.06	1.06
Lancashire	1.14	1.14	1.17	1.17
Mean	0.94	1.01	1.01	1.10
Standard Dev'n	0.18	0.12	0.18	0.18
Coefficient of Variation	0.20	0.12	0.18	0.16

Note. The atypical nature of 1969/70 issues results from the exclusion of school issues by some counties and inclusion by others. Hertfordshire's indices I and K of 0.68 (0.58 if Cheshunt, Letchworth, St. Albans etc. are not included) do not result from incorporation of these authorities but from the inclusion of nearly 7 million school issues in 1969/70 but exclusion in 1970/71 resulting in an apparent decline from 20 to 13.4 issues per capita. Thus 1970/71 data are more reliable.

Table 37. Capital Expenditures per Capita of 45 English Counties

Table of Capital Expenditures per Capita of English Counties adjusted over the Period of Specific Analysis 1969/70 to 1973/74

County	Mean (£)	1969/70	1970/71	1971/72	1972/73	1973/74
Rutland	0.57	0.07		1.37	1.45	
Westmorland	0.22	0.02	0.01	0.24	0.51	0.32
Lincs. Holland	0.06 (*)	0.01		0.01	0.21	
Isle of Wight	0.07	0.01	0.01		0.26	0.05
Hereford	0.05	0.01	0.06	0.02	0.03	0.11
Lincs. Kesteven	0.18(*)	0.01	0.16	0.31	0.25	
Suffolk West	0.09	0.11	0.07	0.07	0.15	0.03
Huntingdon & P.bro	0.19	0.06	0.44	0.22	0.14	0.11
Cumberland	0.13	0.02	0.11	0.05	0.36	0.12
Yorks. E.Riding	0.13	0.01	0.17	0.06	0.19	0.21
Suffolk.East	0.12		0.07	0.23	0.12	0.20
Oxford	0.06	0.04	0.04	0.03	0.12	0.08
Bedford	0.10	0.28	0.06	0.08	0.08	0.01
Cambridge & Ely	0.02	0.01	0.01		0.02	0.05
Yorks. N. Riding	0.10	0.10	0.08	0.11	0.09	0.14
Salop	0.14	0.07	0.11	0.13	0.22	0.18
Northampton	0.13	0.04	0.02	0.15	0.37	0.09
Dorset	0.09	0.02	0.07	0.12	0.10	0.13
Lincs. Lindsey	0.13(*)	0.17	0.12	0.05	0.17	
Cornwall	0.12	0.08	0.18	0.07	0.18	0.09
Norfolk	0.29	0.09	0.28	0.31	0.41	0.38
Sussex. East	0.08	0.01	0.10	0.11	0.09	0.07
Devon	0.13	0.09	0.08	0.13	0.10	0.24
Worcester	0.11	0.08	0.13	0.21	0.08	0.06
Wiltshire	0.15	0.09	0.09	0.15	0.24	0.20
Leicester	0.21	0.05	0.09	0.09	0.29	0.53
Sussex.West	0.15	0.10	0.13	0.12	0.20	0.18
Northumberland	0.15	0.06	0.06	0.23	0.17	0.21
Berkshire	0.12	0.04	0.28	0.12	0.09	0.09
Gloucester	0.11	0.13	0.13	0.07	0.06	0.14
Buckingham	0.28	0.07	0.17	0.17	0.35	0.64
Somerset	0.06	0.04	0.07	0.10	0.05	0.06
Warwick	0.10	0.14	0.21	0.07	0.02	0.04
Derby	0.13	0.08	0.08	0.08	0.28	0.12
Nottingham	0.10	0.05	0.12	0.08	0.12	0.11
Stafford	0.03	0.01	0.03	0.08	0.02	0.02
Durham	0.47	0.37	0.39	0.40	0.55	0.64
Hertford	0.11	0.08	0.13	0.14	0.08	0.13
Surrey	0.13	0.07	0.10	0.10	0.16	0.22
Hampshire	0.32	0.20	0.08	0.19	0.53	0.62
Cheshire	0.23	0.15	0.11	0.16	0.22	0.52
Essex	0.08	0.02	0.07	0.10	0.08	0.13
Kent	0.06	0.02	0.03	0.04	0.09	0.10
Yorks. W.Riding	0.06(*)	0.05	0.05	0.07	0.06	
Lancashire.	0.13	0.13	0.15	0.12	0.11	0.13

Notes

1. 1969/70 data were obtained by dividing aggregate (published) totals by population figures, and then adjusting from the capital accounts of the counties themselves where these were available.
2. 1973/74 published data are incomplete. Adjustments were made from accounts for the purpose of calculating the correlation coefficients of this chapter, but not for the calculation of means in this table, i.e. those indicated (*) are the means of 4 years' statistics.
3. Because the means are a mid-period adjustment (1971/72), adjustment for inflation is unnecessary for the purpose of measuring consistency.

Table 38 . A correlation matrix showing the correlation coefficients between the four indices of change in the rates of issues per capita from 1969/70 to 1975/76

Indices	Indices of Change in Issues I	J	K	L
I	1.000			
J	0.562	1.000		
K	0.767	0.404	1.000	
L	0.062	0.540	0.464	1.000

Key

$$I = \frac{\text{Issues per Head of Population 1974/75}}{\text{Issues per Head of Population 1969/70}}$$

$$J = \frac{\text{Issues per Head of Population 1974/75}}{\text{Issues per Head of Population 1970/71}}$$

$$K = \frac{\text{Issues per Head of Population 1975/76}}{\text{Issues per Head of Population 1969/70}}$$

$$L = \frac{\text{Issues per Head of Population 1975/76}}{\text{Issues per Head of Population 1970/71}}$$

Table 39. Correlation Coefficients between Capital Expenditures per Head of Population and the four indices of change in issues per Head of Population

Indices	Capital Expenditures per Head of Population				
	1969/70	1970/71	1971/72	1972/73	1973/74
I	-0.113	-0.166	0.094	0.154	0.040
J	0.043	0.182	0.314	0.033	-0.105
K	0.248	-0.074	0.114	0.150	0.043
L	0.588	0.284	0.266	0.007	-0.034

Note

For the purpose of the above tables, a sample of 37 'counties' was used for which continuity was possible in the study of the issue statistic, given adjustments for alteration of county boundaries. As the capital expenditure statistics were mainly pre-redistribution, this generally involved 'backward' rather than 'forward' adjustment. As explained, because the issues of 1969/70 for this set were atypical, indices J and L are preferred.

Table 40. A Category Distribution of Inter-Period Capital Expenditure on Libraries for a typical County (Leicestershire) showing differences between Primary and Secondary Data expressed per Capita

Year	Building	Furniture	Sites	Aggregate Absolute	Aggregate per Head of Pop'n	Aggregate per Head of Population in S.C.T. Statistics
	£	£	£	£		
1969/70	3622	1171	5180	9973	2p	5p
1970/71	49132	3648	-	52780	11p	9p
1971/72	12873	3679	17400	33952	7p	9p
1972/73	68712	6583	16547	91842	18p	29p
1973/74	204480	12412	67561	284453	56p	53p
1974/75	216934	14734	5543	237211	28p	34p
1975/76	71869	22978	-	94847	11p	11p
Total	627622	65205	112231	805058	133p	150p

Note

There are several ways of reconciling these disparities; (i) the period from 1969/70 to 1971/72 provides different values because of phasing, and to an extent 1973/74 to 1975/76, but (ii) the 1972/73 difference results from differences in population bases used in the calculation of the 'per head' statistics.

Table 41. Inter-Category Correlation Matrix for 12 Central Libraries constructed 1972/74 with relative cost analysis

	Population	Site Cost	Building Cost	Furniture Cost	Total Cost
Population	1.000				
Site Costs	-0.022	1.000			
Building Cost	0.745	-0.021	1.000		
Furniture Cost	0.584	-0.249	0.776	1.000	
Aggregate Cost	0.735	0.128	0.988	0.752	1.000

	Mean Cost (£).	Relative Cost (%)
Site Cost	15,583	5.91
Building Cost	229,083	86.83
Furniture Cost	19,167	7.26
Aggregate Cost	£263,833	100.00

Note.

These two tables were combined in order to clarify to readers the specific meaning of aggregate cost in this context (i.e. aggregate library sub-category cost) as distinct from aggregate of all capital expenditure categories, used earlier.

Table 42. Inter-Category Relative Analysis for Central and Branch Library Costs 1972-1974, using specific sample from New Library Buildings, verified with primary data

Category	Mean Value	Relative Cost
Population	32,909	---
Site Costs	£10,303	8.3
Building Costs	£104,182	84.4
Furniture and Equipment Costs	£8,970	7.3
Aggregate Capital Costs	£123,545	100.0

Note

The main difference between this total sample and the sample derived only from central libraries is that, in the case of central libraries the relative cost of sites is lower, the relative cost of furniture and equipment is not significantly different, and the relative cost of building is higher. In the above case 'population' means 'population' served by the project as distinct from the total population of the administrative area. Thus the cost is higher, 38p per head of population, (i.e. $\frac{£123,545}{32,909}$)

Table 43. Inter-Category Correlation Matrix for Central and Branch Library Costs 1972-1974, using specific sample from 'New Library Buildings', verified with primary data

	Population	Site Cost	Building Cost	Furniture Cost	Total Cost
Population	1.000				
Site Cost	0.100	1.000			
Building Cost	0.831	0.098	1.000		
Furniture Cost	0.737	-0.040	0.843	1.000	
Aggregate Cost	0.829	0.225	0.991	0.836	1.000

PART III. A CATEGORY STUDY OF THE EFFECT OF INVESTMENT

Chapter Six. The Effect of Library Building

6.1. Introduction.

The previous chapter has tested two hypotheses (i) that the increase of issues over the period is a lagged effect of capital expenditure early in the period, particularly in 1969/70,(though this may have been effective because it is typical of early capital expenditure generally or because of the frequency and dispersion of projects during 1969/70); and (ii) that the increase of issues is an effect of mean capital expenditure between 1969/70 and 1973/74.

A consideration of the exceptions to both hypotheses (i) and (ii) indicates some preference for (i), but not necessarily because there may be a 'lag' of five years between capital expenditure and its effects. It is possible as the bracketed section of the previous paragraph indicates, that the capital expenditure of 1969/70 was effective in producing increases of issues between 1970/71 and 1975/76, because of its very nature in having a large dispersion of projects instead of the concentration of expenditure on larger projects.

There is little doubt of a 'lag' effect in large projects, and sometimes this may be spread over a number of years. The best example is the case of Birmingham Central Library, the largest of all libraries constructed during the period, where the 'peak' of the phased expenditure of £1,157,947 occurred in 1971/72, but the library was not ready for use until 1974/75, and the effect of the expenditure on issues per head of population (from less than 9 to 11.4, a change (%) of 1.29, or 29% increase) was best evidenced in that year. This project was completed quickly for its size, and I use it to illustrate the minimum extent of a 'lag' effect of large projects. Some proposed projects went 'into limbo' to quote a letter from the Derbyshire County Librarian, and the phasing of others was postponed, particularly if they were over a given size. Thus, the 'lag' and frequency effects are not unrelated to each other, for frequency relates to the inverse of the size of project, and capital stringencies had the effect of postponement of large projects by the extension of phasing of costs over time.

In this chapter I propose to examine the effect of the dispersion of capital expenditure on small projects. This can be done in two ways. First, I propose to hypothesise that the issue rate is related to the increase in the frequency of library buildings per head of population in the period, but can do so only by again examining first the weakness of using 'per capita' statistics for the study of different kinds of libraries. Can it be said that the frequency of library building is related to population size rather than to geographical size? If so this statement must be verified with respect to each of the categories of service-point (full-time, part-time, institutional and mobile). If it can be shown that full-time service points are correlated in frequency with population size, then our sample may be used to examine whether there is either (i) a non-parametric association; (ii) a rank correlation; or (iii) a linear correlation between increases in the frequency of library buildings or other service points and increases in the issue rate through the period. For this purpose we should examine increases of service points up to 1972/73. In Section 6.2. we shall be undertaking this 'general' study. It is seen that there is an effect of response of the issue rate to increases in frequency but that it is a non-linear one.

In Section 6.3. I turn to the examination of more particular cases, and examine the effect of expenditure of each of the early years on the issues per capita over the period. For this purpose four sources of primary and secondary data are used; (i) the capital estimates and rolling programmes of library authorities, obtained sometimes from the librarians of those authorities and sometimes from the chief finance officers; (ii) correspondence with county librarians about individual projects; (iii) the 1971 edition of the Libraries Museums and Art Galleries Yearbook (ed Corbett) for confirming some of the primary data from (i); and (iv) where applicable, the two editions of New Library Buildings published in 1974 and 1976, though the use of these particularly was limited, as I shall show.

A frequency distribution is constructed from projects completed in 1969, and there is a subsequent 'category' study of association between small and large projects and those authorities that increased or decreased their issues per head of population during the period. A similar study is undertaken in respect of 1970/71, and a composite frequency distribution is compiled showing the smallness of typical size of the projects completed during the years 1969, 1970 and 1971.

I then construct an estimated frequency distribution from the estimates and rolling programmes of library authorities in 1971, to show that the typical size of expenditure on a project for a year has now increased significantly, and to show that there is considerably less association between this distribution of expenditure and changes in the issues per head of population for the period, than there was for the projects actually completed by 1971/72.

In the cases of the frequency distributions and associative 'category' studies for both preceding paragraphs, the exceptions are studied using primary data from librarians, and it is concluded that, despite the comparatively low significance level when a 'heuristic' rate of increase in the frequency of libraries per capita is used; a detailed study of all projects actually completed early in the period does show that in a highly significant number of cases there is an association between the frequency of library projects completed and positive changes in the rate of issues per head of population. The conclusions of the chapter are then summarised in section 6.4

6.2. The 'General' Effect of Library Building

I have suggested that increases in the issue rate are not simply a function of capital expenditure, but of the extent of the dispersion of capital expenditure (geographically) on small and medium-sized projects, that capital expenditure can be effective if small project demands can be quickly satisfied, but that large projects have an inbuilt 'lag-effect' particularly if they are sensitive to increases in the project costs phased over time. The frequency of projects on which a given amount of capital may be spent is the inverse of the 'modal' size of project. Thus, it may, at this stage, be enquired whether a positive change in the frequency of libraries per head of population necessarily produces a positive increase in issues per head of population. The question is a complex one, because of the weakness of the nature of 'per capita' comparison, a weakness that has already been discussed in previous chapters. Although a useful 'heuristic' tool, the ratio 'frequency of library buildings per head of population' is difficult to define not only because of differences in county area sizes, but because of subcategories of service points, those open (i) between 30 and 59 hours; (ii) between 10 and 29 hours; and (iii) for less than 10 hours per week; and (iv) institutional service points and (v) mobile libraries. In some subcategory cases it is evident that there will be greater correlation between frequency of service points and size of area than between frequency of service points and size of population, so that to discuss increases in the 'frequency of library buildings per head of population' will be meaningless, because of differences in sub-category provisions for different sizes of population.

The report of the Working Party on Standards of Public Library Service (HMSO 1962) and the recommendations of the Library Advisory Councils for England and Wales (93) are of limited use, particularly because of lack of implementation,(particularly of the latter report, for it was published during our period) and because of the heuristic nature of any standard in its application to particular circumstances.

It is however instructive to note particularly recommendations 103 and 104 of the earlier report that there should be libraries open for over 29 hours per week for populations of over 4,000, and over 10 hours per week for populations of over 1,000; and mobile libraries and staffed centres for smaller populations.

93. Boyle (ed) Report of the Working Party on Standards of Public Library Service (HMSO 1962); Library Advisory Councils for England and Wales: Public Library Service Points (HMSO 1971).

Libraries are, of course, built to be full-time service points. Part-time service points are usually acquired by an authority or rented. Hence our definition of 'frequency' of service points, for this study, should be restricted to full-time service points. Using the present set of library authorities and the frequencies of service points of each of these categories for 1972, the last year of 'effective' capital expenditure, the regression of service points on (a) population and (b) geographical size is instructive.

For the larger branch and central libraries (i.e. those open between 30 and 59 hours per week), excluding a few special cases of larger branch and central libraries open for more than 59 (i.e. 60 or over) hours per week: the correlation between library frequency and population size is 0.872, while the correlation coefficient between library frequency and geographical size (acreage) of county is only 0.028. The best linear regression equation for describing the relationship between library frequency in this category and population size is:

$$F_1 = 2.243 + 39P_1 + U \quad (93a)$$

where F is the frequency of library buildings in this category, P is a 'million' unit of population and the subscript 1 indicates this category of library. Clearly, there is a relationship between frequency and population size for this category, the regression constant of 2.243 can be ignored, and we can meaningfully measure in frequencies of full-time libraries per unit of population. A logarithmic regression line does not better fit the data, for it produces some large regression errors (particularly in the cases of Lancashire, Surrey and Kent).

In the case of libraries open 10 and under 30 hours per week, those associated by the reports (93) with smaller populations, there is a correlation coefficient of 0.431 between library frequency and population size but of 0.355 between library frequency and geographical size of county (acreage). For this category of service point, the regression equation that best fits the data is:

(93a). U, in this case, is the regression error component, as before

$$F_2 = 12P_2 + 8G_2 + U,$$

where the subscript 2 represents the category of library service point open between 10 and 29 hours per week, and where F, P and G are respectively the frequencies of library service points, the frequencies of 'million unit' and of 'million acre' measures of population and area.

It is stressed that this linear regression equation is not intended to be 'explanatory' though the partial F-values in this case were 9.1 and 6.0 respectively. The purpose of the regression equation is simply to show that, in this case, the measure 'frequency of library service points per unit of population' is not a particularly useful standard of measurement because of 'dependence' of the frequency of library service points in this category on the geographical size of counties.

Those counties whose error terms were positive (i.e. whose frequencies exceeded those expected) using the above equation were, inter alia, Cambridgeshire, Derby, Leicestershire, Nottinghamshire and Warwickshire, these five cases exceeding the standard error of the regression error. Four are Midland counties where high frequencies in this category are compensated by lower frequencies in other categories. The cases that had exceptional negative regression errors were Avon, Cleveland, Durham and Surrey, and these exceptions are self-compensating in other categories. For example Surrey has a large number of full-time libraries. But the regression and correlation of frequencies of libraries in this category with frequencies of population and size of county illustrates that it is inadequate to measure the change (i.e. increase or decrease) in the frequency of service points per head of population in this particular category because of lack of comparability between large and small area counties.

For libraries open less than 10 hours per week, the correlation coefficient between service points and population is 0.589, but that between service points and geographical size in this category is only 0.099. There appears to be

a prima facie case for using the 'per head of population' measurement, although increases in the frequency of service point in this category would hardly come under the description 'capital investment' at all. In fact, there are other reasons for not using the measure 'frequency of service points per head of population' in this category. They are that :
(i) the distribution of frequencies is very abnormal; and
(ii) these are reflected in some of the measures of location and dispersion (e.g. mean = 17.59, but standard deviation = 41.4). Despite this rather small mean, a few counties have exceptionally high frequencies of service points in this category, e.g. Essex (162) and Kent (217). For this reason there could be no useful purpose in construction of a linear regression model to define the relationship between population and library frequencies.

In the case of institutional service points the correlation coefficient between service point frequencies and population size is 0.651 and significantly greater than that between service point frequencies and the area size of county (0.118). The regression equation that best describes the relationship between frequency of institutional service points and the size of population is:

$$F_3 = 7.544 + 124P_3 + U$$

where the variables are as signified earlier and 3 is the subscript that indicates institutional service points.
The case against the use of the service point (institutions) indicator in any general study of the effect of frequency of service points on the issues per head of population is based on the premise that the relative size of institutional lending is small. However, the changes in institutional service points were calculated and expressed per head of population and entered into a multiple regression equation using each of the indices I,J,K and L defined earlier. The F values in respect of this variable showed that the effect of any increase in institutional service points per head of population on lending per head of population was insignificant.

Finally, mobile libraries were also tested against population size of county and geographical size of county to assess the measure of comparability between frequencies of mobile libraries and both these 'size' variables. In this case the correlation coefficient between frequency of mobile libraries and population (0.531) was less than that between the frequency of mobile libraries and the area of the county sample variable values, (0.671).

The regression equation that best defined the relationship between the frequency of mobile libraries and these two variables was:

$$F_4 = -0.116 + 7G_4 + 7P_4 + U$$

where subscript 4 is the category, 'mobile libraries', and G and P are respectively the 'million acre' and 'million person' unit measured sizes of the two variables respectively.

The result of this study of regression equations defining the relationship between categories of service point frequencies and the two measures of county size is that we need to redefine what constitutes an increase in the frequency of service points per head of population. The asymmetric distribution of part-time libraries, the lack of usefulness of the measure in respect of mobile libraries and the comparative insignificance of 'institutional' service points all indicate that any 'general' study of the effect of increase of frequency (per capita) on issues (per capita) should be confined to full-time libraries (30 hours per week and above) for these are correlated with population size sufficiently to make the measure useful and they constitute capital investment in the majority of cases. This description does not, of course, include extension and rebuilding of existing libraries or the effect of amalgamation, but at least, it is only this category of library that can provide the basis of a 'general' model defining the effect of capital expenditure on issues.

Table 44 provides changes in library frequencies (full -time service points) for counties in our sample from 1969/70 to 1973/74, and these are adjusted in the second column and expressed per 100,000 unit of population. Before testing these with changes in the issue rate under indices I,J,K and L it was decided to question whether these indices were responsive to absolute frequencies of full-time service points rather than to changes in frequencies. Thus, the frequencies were also converted and expressed per 100,000 unit of population. Strangely the expenditure during the period was not 'remedial' in the sense that money was necessarily spent in counties where frequencies of libraries per head of population was low. Instead there is a positive correlation (0.283) between frequencies of full-time libraries per head of population and changes in those frequencies between 1969/70 and 1973/74 expressed per head of population.

Thus, we questioned whether indices I,J, K and L were correlated with aggregate frequencies of libraries per head of population in 1973/74, and for this purpose used:

(i) a 2 x 2 category test of association between high and low values;

(ii) Spearman's rank correlation coefficient; and

(iii) Pearson's correlation coefficients;

because of problem of non-linearity that has already been explained.

The 2 x 2 category test using medians of both variables showed that the categories were

a = 11; b = 7;,c = 7; and d = 11.

This does indicate some association between aggregate full-time library frequency (per capita) and the increase in issues but the association is not significant. For Fisher's test at the 5% level of significance where b = c = 7, a and d require to each be as high as 14.

Spearman's rank correlation coefficients between aggregate full-time library frequencies and indices I,J, K, and L ranged between 0.21 and 0.32. Again, there is seen to be association but this is not significant.

It is interesting to observe that when the Pearson correlation coefficients are computed between aggregate frequencies of libraries per head of population in 1973/74 and the indices I,J,K and L , the only significant correlation coefficient is between aggregate frequencies of full-time libraries per head of population and index K, the index of change in the issues per head of population between 1969/70 and 1975/76 (0.325). This is reasonable for the frequencies were calculated for 1973/74, and there is no need to account for a lag when the variable concerns physical units, rather than capital expenditure. (93b).

The problem posed by the general model is accentuated, however, when measures of association are computed between <u>changes</u> in the frequencies of full-time libraries per head of population and <u>changes</u> in the issues per head of population. We would, in view of the reasoning of chapter five, expect a higher measure of association between changes in issues and changes in library frequencies, rather than the aggregate frequencies themselves, but this is not so. For <u>changes</u> in library frequencies (full-time) per 100,000 unit of population, there were chi-squared value-equivalents of between 0.91 and 1.77, using the median test of association with <u>changes</u> in issues per head of population. These 2 x 2 coefficients are not significant at the 5% level. The calculation of Spearman's rank correlation coefficient for each of the indices produced values between 0.03 and 0.31, while the Pearson values were lower than those for aggregate library frequencies.

The exclusion of some exceptional cases does improve the model somewhat. For example index L shows an unusually high increase of issues per head of population for Bedford, (1.76), but in this case two capital expenditure projects affected the variable, that for Bedford library (central) where the last major phase year (1969/70) contributed 28p to the per capita capital expenditure, but made no difference to the frequency of libraries, for Bedford Central

(93b). Obviously because this is coincident with buildings actually completed by 1973/4.

simply replaced an existing library; and that of Leagrave (Luton) which was closed in 1974/75 temporarily and rebuilt and reopened in 1975/76 in sufficient time to affect the 1975/76 issues statistics. Thus regression on the frequency of full-time libraries is inapt in this case. Gloucestershire was similarly affected by the replacement of an existing library by a new central library early in the period. The statistics of other counties, such as Durham and Norfolk present similar analytical problems when changes of issues are regressed on changes in the frequencies of libraries. The elimination of these exceptions and the consequent reduction of our set of counties to 30 does produce a correlation coefficient between the changes in the frequency of library buildings per unit of population from 1969/70 and 1973/74 and the changes in issues per capita from 1970/71 to 1974/75 (index L) which is 0.389 and therefore statistically significant at the 2% level, and incidentally for this refined sample set of 30 counties the correlation coefficient between aggregate frequencies of library buildings per capita and changes in issues per unit of population is only 0.355.

The regression equation that best defines the relationship between the two variables is:

$$L = 1.059 + 0.051\Delta F_1 + U$$

where:

L represents values of index L, proposed in chapter five;

ΔF_1, measures changes in the frequencies of full-time libraries (i.e. category 1) per 100,000 unit of population; and U is the regression error component.

It is appreciated that the value 0.051 is not a particularly low value, although it appears to be a low regression coefficient, for it is expressed in 100,000 units of population. Ignoring the regression constant it is equivalent to saying that each new service point for 100,000 people produces a marginal increment of 5,100 issues or over £2,000 per annum. But the modal cost of each project was not much more than

£25,000 for 100,000 people and this benefit must be regarded as 'marginal' in the accounting sense, unaffected by gross expenditure, and a clear return on capital investment of nearly 10% for each project for every 100,000 people. Yet, the fact that exceptional cases, particularly early central library constructions have to be excluded in order to achieve this approach to a 'general' model serves to show that attempts to 'generalise' the relationship between the frequency of full-time library construction and the issue rate pose numbers of yet-unanswered problems. It is with a view to answering these problems that we must now move from the 'general' to the particular, and consider the frequency distribution of building projects for each of the years concerned.

6.3. Sources of Primary and Supplementary Data

In order to obtain data for the study of the effect of particular projects on issues it was necessary to consider several sometimes conflicting sources of data.

First we must consider sources of information about buildings actually completed before 1972 or that appear in the rolling programmes of library authorities and were due for completion before 1974. For this purpose capital estimates were obtained from a large number of English library authorities, particularly county authorities, and some others (e.g. Welsh authorities). The process proved tedious, for although one could obtain actual historical cost of completed contracts by the aggregation of inter-year phased costs, the estimates at 1972 were particularly unreliable. Yet historical costs for later years were not appropriate unless projects were actually completed in time to affect the rates of issues per head of population during our period and few (relatively speaking) were completed in time to have this effect.

Second, and sometimes more meaningful, statistics were obtained from correspondence with County Librarians. Letters were sent during 1976 and 1977 to both county librarians and the directors of libraries of the new Metropolitan District Councils requesting information about the total cost of each library constructed during the period from 1969 to 1973. Some librarians did not respond or were unable to give sufficient information because of the effect of boundary changes or the amalgamations effected after the 1972 Act. In some cases therefore responses were understandably incomplete, but in a significantly large number of cases these statistics agreed with those from other sources.

The third method of obtaining (and occasionally of checking) some values was to obtain values from the questionnaire responses in respect of capital projects tabulated in the Libraries, Museums and Art Galleries Yearbook, edited by E.V.Corbett in 1971. The limitation imposed in the use of this secondary data is that all projects are not listed, though the extent of agreement with the capital estimates is very good. But the basic historical cost information covered the years from 1961 to 1971, and thus the two later years of our particular concern (i.e. to 1973) could not be the subject of historical cost information from this source.

A fourth source of supplementary data is the publication New Library Buildings published jointly from an architect/librarian working party by the Library Association. The two relevant issues are those of 1972 and 1974. The major limitation of this supplementary source of data is that it simply provides for each project the aggregate unphased site, buildings and furniture cost without reference to the distribution of the costs over time and the actual relationship between costs and pre-existent estimates.

This important limitation can be best illustrated in the phasing of the Teignmouth,Devon library where initial (1967/68) site investigation cost £181, but the peak of phased capital expenditure for building costs was in 1971/72 (£13,973) and 1972/73 (£22,851) and for furniture was 1972/73 (£1,867) yet with no completion effect until after 1974/75. The aggregate is, of course, not included in these publications because of non-completion when they were compiled, and when published does not take into account the effect of inflation on the phasing of the project.

It is with the limitations of these four sources of primary and supplementary data in mind that we proceed in section 6.4 to examine the yearly effects of projects.

6.4. The timed frequency distributions and effects of projects (93c).

In this section we consider briefly the frequency distribution of a large sample of projects completed in 1969. This is followed by a sample of larger projects completed in 1970 and 1971, the sample size for either of these two years being insufficiently large for single analysis. This is followed by a combined frequency distribution of projects for the three years 1969, 1970 and 1971 and an assessment of the effect of inflation on the measures of location and dispersion of this sample. Though I use the term 'sample' each frequency distribution includes most of the English projects completed in these years.

I then compile, from local government estimates and rolling programmes, a frequency distribution of expected costs and projects for completion from 1972 onwards. These are then compared with capital expenditure statistics and disparities examined. The effect of local government stringencies after 1973/74 on the estimates of 1972 is examined to show that many plans were completely altered during the period, and the effect of such alterations on building and on the issue statistic. This study shows how the conclusions of chapter five, and of the 'general' model of 6.2 are validated by such data as are available.

6.4a The pattern of library construction in 1969.

The pattern of library construction in 1969 included a large number of small projects, and from available capital expenditure accounts and estimates a frequency distribution of 41 of these projects has been compiled. Although this is termed a 'sample' it consists of most of the projects completed in the period. This can be verified by comparing the frequencies of full-time libraries in Public Library Statistics for 1968/69 and 1969/70 where there is indicated between the two years:

(i) a decline of full-time service points in county boroughs and London boroughs; but

(ii) an increase of about 40 full-time service points for counties, non-county boroughs and urban districts.

(93c). This subtitle means frequency distributions of costs for particular time periods. See Tables 45 to 48.

Table 45 provides details. Despite the apparent large frequency in the class 'over £100,000' these are, in fact, spread over the range '£200,000 to £600,000' so the frequency distribution is unimodal, but like many of the frequency distributions that we have previously examined in this thesis, it is positively asymmetric. The mode is in the region £24,630 to £25,000 for 4 projects are in this range. The median project is £29,000 and the mean is, of course, atypical of the frequency distribution for it is £61,796, and it is affected by the six very large projects at Wanstead, Gloucester, Doncaster, Basingstoke, West Norwood and Thurrock.

Thus, it is to the region £24,630 to £29,000 that we must be directed to answer the question of 'typical cost' of projects in this year. Most of the projects were very small quite apart from the fact that values for this year would be relatively less, in any case, for they were not affected (by comparison with subsequent years) by inflation during the period.

It is with this frequency distribution in mind that we must ask two important questions:

(i) How many of these projects were associated with counties that increased their issues per capita more than the median change of index, using for example, index L, during the period; and

(ii) Was there more association between large projects and the change of issue rate than between small projects and the change of issue rate?

In answer to (i) about 64% (i.e. 26) of the 41 projects were associated with counties that experienced a change in the rate of issues per head of population larger than the median change in index L; but

in answer to (ii) the size of project did not appear to affect association with the issue statistic in any way whatsoever. Thus, even among the six largest projects the same ratio (4:2)(about 67%) was apparent. Of course, some of these large 'central' projects were affected by large land values, particularly in the London area. This sample, of course, can be, and is, more widely spread, than that which included English counties only, for our general model of 6.2. for we are now considering individual projects.

Let us consider the six largest projects. Two of these projects were London libraries, Wanstead (Redbridge) and West Norwood (Lambeth). Wanstead was completed in October 1969 at a cost of £108,738. There was no site cost, i.e. it was not chargeable to the library committee, and the furniture element was £4,400, so that most of the cost (£104,338) was in respect of building. The issues of books per head of population for the whole of Redbridge increased from 13.2 in 1969/70 to 13.7 in 1970/71 (i.e. the year after the completion of the library) at a time when, as I stated earlier, the general rate declined. Hence, the increase (0.5) is a small representation of the <u>real</u> increase. Further, the library was only intended to serve 20,000 (that is, less than one-twelfth of the whole population of Redbridge). The global increase was not fully attributable to Redbridge's Wanstead library, but, if it had been, it would have represented a 'social income' of £40,000, a return of nearly 40% on investment, (gross). It is important to appreciate that this 'return' was maintained. For example, as late as 1975/76 the rate of issues per head of population was 13.8.

The West Norwood case is dissimilar. It cost £365,643 but was spread over some earlier period, particularly site costs £11,232. The library was intended for 45,000 people and was also opened in 1969, but had other functions. Though a 'branch' library, it was in effect a zone library controlling 2 branches. The cost contained that of a multi-purpose hall and cafeteria. Thus, some of the investment is of a 'central' and 'administrative' nature. In fact, the issues of West Norwood responded to the investment, but this response was lost in the general decline for Lambeth (9.4 to 9.1 between 1969/70 and 1970/71), a factor associated with the general decline in service points for Lambeth. In fact, the decline of both issues and service points are a feature also of later years.

We may now move from London boroughs to the other four cases, these being associated with counties in our earlier sample. Gloucester has one of the highest rates of increase, especially in terms of index L, and this may have been both the result of central library construction and that of Yate library. Issues per head of population increased from 11.9 to 12.7 (city) between 1969/70 and 1970/71, and this was maintained in other years. For the specific case of Gloucester city before the effect of the Act of 1972, the central library had an incremental effect of 70,000 issues per annum. This would, in terms of social benefit, be an estimated £20,000, on an outlay of £132,000, (using the criteria of chapter 1) and therefore represent a 15% return on investment, an increase that was maintained for future years.

The project at Doncaster, unlike that of Gloucester city, was included in New Library Buildings, but information from other sources indicated that the rate of issues per capita did not change significantly, but the issues of the county indicate a generally higher rate than the overall mean for the 39 counties in our sample (12 issues). It must be regarded as a doubtful case, but not one that necessarily disproves the hypothesis of association between projects and the rate of issues per capita. The population for which the building was intended was 85,000, it was not completed until the end of the year, and it was designed as a Central library, with an administrative element in the cost.

The fifth project, Basingstoke, cost over £200,000 but was under the aegis of Hampshire through the period. It is associated with a county whose issue increases were greater than the median, but there were reasons for such increases, and as Basingstoke was only one of 21 full-time service points in the county, there is no ready method of proving association between capital expenditure and the issue statistic. (93d).

Finally, Thurrock in Essex must be considered. The increase of issues per capita in Essex by index L is good (28%), but Thurrock became part of Essex after the 1972 Act. The investment was two-phased, but the first of these phases is relevant to our study, for the second phase of the Thurrock project was concerned was the construction of a theatre. Further, as Thurrock was administered independently of Essex during construction of the first phase (the library itself) we can readily measure the increase of issues, ~~from~~ between

(93d). But, of course, lack of association may not be readily 'proved' either.

1,438,487 and 1,632,220 (i.e. from 11.3 to 12.8 per head of population) during the period. If the increase (nearly 200,000 issues) is converted to social benefit using the criteria in chapter 1, the minimum benefit at the 95% confidence level would be £67,000, a gross return on investment of 13%.

From this detailed survey of the effect of six major projects it is clear that the 'effect' of large projects is not significantly greater 'per head of population' than small project effects. In both cases, is there a clear effect for two-thirds of the projects and the remaining one-third is doubtful, but insufficiently doubtful to disprove the hypothesis of association. Doubtful cases can be explained by reference to other factors, i.e. the administrative, ancillary and other content of capital expenditure and the reduction of service points, elsewhere in the administrative area. (93e).

There is insufficient space in this thesis to deal with all effects of small projects, but each was studied, and the exceptions to the hypothesis of association resulted from factors unassociated with this hypothesis. On the other hand, many clear cases of association could be evidenced. For example, the case of Horncastle (Lincolnshire) with a net project cost of £18,472 involved conversion from a part-time service point to a full-time library, but was accompanied (to use specific statistics forwarded by courtesy of the Lincolnshire (Lindsey and Holland) librarian) by an increase of book-issues from 60,798 in 1968/69 to 69,966 in 1969/70, rising to over 90,000 in subsequent years. In this case the minimum immediate benefit from the initial increase can be estimated at £3,000 (a gross return of 17% on investment), quite apart from the other benefits of the project. Tests conducted with the data of Bolton (Lancashire), Box (Wiltshire), Cotgrave (Nottinghamshire) and Kings Langley (Herts) show similar patterns, and return on investment varying between 14% and 17%. In all these cases there were no transfer increments. Though, (93e) for example, in the case of Horncastle there was a temporary decline in issues for nearby Louth, this did not last for more than a year, and may have been unassociated with the Horncastle

(93e). The converse of the Epsom-Ewell effect of Tables 65a and 65b.

project, for increase of membership at Horncastle following the project was 1,704 to 3,020 in three years, while Louth also increased but less significantly.

Thus, in the vast majority of cases there was association between each project and the issues of books from libraries immediately following construction, but this association was not greater for large libraries, and where detailed calculation was possible, the return on investment generally exceeded 13%, (gross), if the criteria of chapter one for the conversion of issue statistics to estimates of associated benefit are observed.

6.4b. Library Building during 1970 and 1971

I intend dealing with these years jointly because of the smallness of the sample size for individual years. Table 46 provides the frequency distribution of project costs for 1970 and 1971. It is a smaller sample, and the decrease in project frequency may be evidenced both from comparing the frequencies of service points in Public Library Statistics between 1969/70, 1970/71 and 1971/72 and from the project dates given in New Library Buildings. Again, though I use the term 'sample' the set includes most of the projects undertaken during the period, certainly those relevant to our sample of 6.2.

For this sample, the median project is £33,500 and the mode is £25,000, the small differences with the distribution of Table 45 being explained by inflationary differences. But the mean is larger (£66,601) and the standard deviation (£99,706) certainly reflects, not the extent of variability, but the effect of a few large projects on this asymmetric frequency distribution.

Again, if we ask questions (i) and (ii) of 6.4a of this data, the answers are similar., for (i) over 67% of relevant project construction is associated with authorities that increased their rate of issues per head during the period using index L, but there is (ii) no greater association for large projects than for small ones. Again, specific cases were investigated and the effects were similar to those traced in 6.4a.

With this data we may now attempt to construct a frequency distribution for all three years 1969,1970 and 1971.

The result is provided in Table 47. It can be seen that the distribution does not conform with a Relative Poisson Frequency Distribution, as in the distributions provided in earlier chapters, for it features a distinct kind of abnormality. It is a composite of two frequency distributions (ignoring the inflationary effects of the period from 1969 to 1971);

(i) a near-Poisson, but 'peaked' distribution for small projects; and

(ii) an abnormal (almost rectangular) distribution of large projects.

Thus, to use the data obtained from proximation with a simulated Poisson distribution, though there is some similarity of small project frequencies with the formula:

$$f(x) = (e^{-2.85k} \; 2.85k^{r})/r!$$

where k = £10,000:

there is no conformity of large and 'central' projects to this frequency distribution because of their individual natures. I stress again that this distribution ignores the 'small' inter-year inflationary effect of the period from 1969 to 1971.

6.4c. The Estimated and Real Building Costs between 1972 and 1974

We have already witnessed the reduction of small projects in the years of our period to 1972, and I have not stressed differences between actual costs and estimates because these are not relevant to our study. It is only after 1972 that significant planning disparities appear. During the period 1972 to 1974 property prices doubled, particularly in south-east England because of the effect of land-values. In some cases, sites had been acquired before 1972, in others they were charged to other authority committees, and in others the increases were anticipated in the estimates and rolling programmes of the library authorities. But despite this the actual 'phased' costs of most projects completed between 1971 and 1974 were between 25% and 30% greater than their pre-existent estimates.

Table 48 provides the frequency distribution of estimated costs for a very large sample of projects planned in 1971. It has

been constructed from the capital estimates and rolling programmes of library authorities in 1971/72, and is again abnormal, for it is a composite of two distributions of two categories of building:
(i) the branch library category with a mode of £60,000; and
(ii) the 'central and administrative' category with a less identifiable mode, but a range between £100,000 and £1,290,000. This is analogous to (i) and (ii) on page 258.

To illustrate the frequency distribution with equal frequency categories, a large class interval is required, thus I have used a £50,000 class interval in contrast with former frequency distributions. Because of the abnormal nature of this composite frequency distribution, no purpose was served by illustrating the simulation of skewed frequency distributions in this text. It is sufficient to say that the expected value (λ = np) of such a distribution was obtainable at about £80,000, and that deviations of small projects from the simulated Poisson curve were explained by:
(i) different estimating techniques of library authorities, for some took more account of inflation than others;
(ii) a tendency to use the range £50,000 to £90,000 when estimating costs of branch libraries of the small category; and
(iii) the existence of a 'floor' constraint on estimates.
This 'floor' was about £40,000, and finance officers appeared reluctant to estimate below the value, even for small projects, because of contingencies.

The 'central library' component comprised only 23 of these (20%) projects yet had a less identifiable frequency distribution, but accounted for over 37% of the estimated capital expenditure in the capital estimates studied.

If we apply the conclusion of chapter five and of 6.2 to our study it would be unlikely that we should find association between these estimates and the increase in the issue rate. Of the 87 branch library projects in our sample of estimates 55 were associated with counties and other authorities that witnessed increases of issues using index L (median) for category distinction, while only 32 were associated with counties whose issue increases fell short of the median for L.

There is thus some association between the estimates for branch projects and the movement of the issue statistic between 1970/71 and 1975/76. This cannot be said of central library projects. Of these, only 12 out of 23 projects were associated with counties that had positive movements in the issue rate greater than the median for L. We must now proceed by investigating this discrepancy to assess the reason for this lack of association.

6.4d. The Effect of Modifications in Policy.

During the years between 1972 and 1974 library authorities faced the problem of attempting to implement their pre-existing estimates against a background of ever-increasing costs and capital stringencies. The alteration of the distribution of large and small projects for these years was the effect of the different ways in which library authorities approached the problem:

In some cases, estimates had taken inflation into account, and the phasing of projects had been carried out conservatively. In this small minority of cases actual costs did not exceed estimates, and the projects were completed relatively early in the period.

In a second category of cases, the actual costs exceeded the estimates by as much as 35%. If the project had been planned such that it was nearing completion there was little alternative but to attempt to meet these costs.

But the dilemma of increasing cost imposed on authorities the question whether small projects should be completed first and large ones have their inter-year future phasing postponed; or whether alternatively large projects should be completed and small ones be either cancelled, postponed indefinitely or met by some kind of temporary construction.

Thus, there are two subcategories. Some projects were cancelled or postponed, particularly when small projects were given priority and large ones were driven into 'limbo', not necessarily by longer phased completion, but, in some cases, by indefinite postponement. Others, mainly small projects, suffered from what may be styled a

'Giffen' effect. They competed with larger projects that had to be completed because they were nearing completion. Funds were diverted to the larger projects and thus this particular category was met below the original estimates, but in a considerably less ambitious way.

6.4d(i). The effect of realistic estimating.

In a small number of cases the estimates were met. For example, the Ambleside library was estimated at £50,000 but the actual building was completed at £45,000. Although the category of projects which were completed under the original estimates was small, the difference between estimates and actual costs varied significantly, and the variation was not only the result of phasing of projects and the stage that had been reached before the effect of accelerated inflation after 1971/72. It was also affected by the 'realistic' or 'unrealistic' ways in which inflation was anticipated. Yet, not all cases of costs not exceeding estimates resulted from such 'realism'. Some were the result of the 'Giffen' effect that is treated under 6.4d(iv). The library at Redhill, Surrey is a particular case of this effect.

6.4d(ii). The varying effects of inflation.

The effect of property inflation was relatively small prior to 1971/72, and became highly significant contemporaneously with the reduction in local authority capital planning because of expenditure constraints. Thus, the difference between actual and estimated expenditure varies in respect of nearness to completion before 1972/73. Thus, even with the same authority (Cornwall) with similar estimating procedures the effect of different phasing was that one project estimated at £14,500 cost £18,500 and another estimated at £25,000 cost £33,500, a difference of cost increase between 27% and 34%. When counties chose to complete large projects early the effect was only a 20% increase. For example, the Wiltshire (Chippenham) Regional Headquarters(Buildings Phase 1) was estimated at £72,000, but because it was mostly completed before 1974 the increase in aggregate cost was only about 21%

(i.e. to £87,500). But, for example, the postponement of a small project to enable a larger project to be completed as at Leagrave (Luton) involved an increase from an original estimate of £63,000 to actual completion costs of £107,360. The effect of postponement on large projects was relatively similar but, of course, because they were larger, much more significant in absolute terms. For example, the Salisbury library project was estimated to cost £214,000 in 1971, but by 1971/72 the estimate had risen to £490,200 because only £150,000 of the expenditure had been incurred before 1974. On the other hand, large projects that were completed early in the period (e.g. Bedford: estimate £386,000 including £138,000 site, and actual £396,076 including site £138,000, despite a one-year lag) did not suffer badly from the effect of post-1972 inflation because of its nearness to completion and because of good estimating. Thus, nearness to completion helped determine priorities, but the commitment on central and large library projects was such that, if they had already involved large expenditure or were nearing completion, they received priority; while, if costs had only involved site-acquisition they were postponed to assist smaller, more essential projects, and if construction costs had been small, they were phased over longer periods. In general a 'lag' of two years involved an accounting 'variance' of 20% or less. Another typical example is the difference of £14,375 (20%) (i.e. from £70,000 to £84,375) in the case of Oxted in Surrey. Thus, we deal with some variety between estimates and actual costs at the time of significant inflationary increase, and so with consequent differences in policy, but with obvious preference for large projects where there had been significant outlay to ensure that these were completed. We are thus concerned with two effects of policy decisions:

(i). a 'limbo' effect of indefinitely postponing large projects, with small phased past costs in 1972; and

(ii) a 'Giffen' effect of cost-paring small projects where these were necessary but competed with large projects.

6.4d(iii). The 'limbo effect'

Cases of this effect have already been provided, but it is necessary to summarise them. For example, estimates for a Derby central library, and for one at Chesterfield appeared in estimates in 1971/72. These were not implemented prior to the stringencies of 1972 and afterward, and thus they were put 'into limbo' to use the words of a Derbyshire librarian, or 'shelved indefinitely' (93f) to quote the Hertford County librarian. In the case of Derbyshire, the concentration was on small, feasible projects. For example, Derby County Council spent £68,658 in 1973/74 on new buildings.

If large projects had undergone no significant outlay they were shelved; if site had been acquired (as in the case of Newport, Isle of Wight) their phasing was postponed, while if there was commitment to finish large projects because of past-outlay, smaller projects were postponed. To quote one example, the Luton estimate for the Leagrave library was £63,500 in 1971/72 before the 1972 Act. Luton was incorporated into Bedford, and there was a commitment to finish Bedford central library £396,076. Leagrave was postponed, finally costing an aggregate of £107,360, £91,860 on buildings and £15,500 on furniture and fittings.

6.4d(iv). The 'Giffen' effect.

Although I have used the term 'Giffen' effect to illustrate this particular treatment of project costs, there is, of course, not an exact parallel with the 'Giffen' effect in economics, but the similarity illustrates the treatment. It is that when an authority is faced with two projects, a superior one and an 'inferior' but essential one, the increase in the cost of the superior one may lead, not to the postponement of the inferior project, but to the completion of an even less ambitious inferior project at a reduced cost. This is not the only treatment of an inferior project. It may, of course, be postponed or 'shelved indefinitely' as in 6.4d(iii) depending on whether it is 'essential' or not.

(93f). A similar letter from the present Hertford librarian regarding a Hatfield project.

The cases of Redhill and Oxted in Surrey are useful for the purpose of illustration. These projects were planned as projects of £70,000 or more, but Oxted was required to meet the needs of 8,600 borrowers with a probability of 253,000 issues while Redhill is in an 'inferior' area and has a likely 7,700 borrowers and 216,000 issues per annum. Redhill was initially planned to cost more than Oxted. The effect of capital stringencies was that Oxted was completed at a greater cost (£84,375) and opened late in 1972, thus being completed early to make way for the much greater cost of completing Woking by 1975 (ultimately costing £388,000) but that Redhill was satisfied by the construction of a temporary building consisting of two linked demountable huts, and costing only £8,000. Thus, the actual expenditure on Redhill was considerably less than was estimated. A similar case is Chester-le-Street in Durham where the library was completed at 60% of the original estimate.

This is not to say that the effect of increased expenditure was necessarily that of reducing expenditure on a competitive inferior project. Occasionally, where the 'inferior' project was less 'essential' because of its proximity to the 'superior' project the result was indefinite postponement. Thus, the Hertfordshire estimates included in 1971 proposals for a Hatfield extension at (93f) £65,000, an Oxhey extension at £70,000 and a new central library at Welwyn Garden City to cost £226,000. Because the Welwyn project was an administrative one, it received some priority for:

(i) the building was to house divisional offices;
(ii) some of it was to be used for stack areas for relegated bookstock; and
(iii) it was to house the County music collection.

It was thus completed early at a cost of £225,000 on the building and £17,300 on furniture and equipment, but the Oxhey scheme was rendered less essential, and remained on the Hertfordshire estimates to be completed in 1978/79 at revised costs that include £93,445 for building, £12,900 for furniture and equipment and a total increase of £40,580. Because of its less importance this project was postponed.

However, the effect of stringencies on Hatfield library proposals was rather different. Hatfield is near to Welwyn, and the proposal for Hatfield was 'inferior' to that for Welwyn. Hertfordshire faced other competing demands, due to inflation, for a library at Hoddesdon costing £350,000 and an extension at Oxhey was to be preferred to Hatfield, as it affected an otherwise small library compared with Hatfield. Thus the proposal for Hatfield was 'shelved indefinitely'. (93f).

6.4d(v) Subcategory Differences in Capital Expenditure

We can, from the above discussion, assess that the reason for greater concentration of capital on central projects and less dispersion, with its effect on inter-period correlation after 1971, is primarily that it was a reaction to large projects that were partly completed at that time. In chapter five, I showed that the correlation between building cost and aggregate, and its relative importance in the cost of aggregate library construction was such that the effect of other subcategories on the issue statistic was unlikely. We have already shown that, in the case of Redhill, for example, the proportion of cost of equipment was affected by the nature of the building, and a list of all projects completed between 1970 and 1974 does present us with considerable variation for furniture and equipment, but this does not usually result from estimate changes. Central libraries, such as Camden (5.3%) and Bedford (2.5%) tended to spend less on furniture and equipment than the mean (7.7%) for central libraries, partly because of the effect of multi-storey building; while in the case of the library at Sutton-in-Ashfield nearly 20% of the total project costs were spent on furniture and equipment.

But despite this variation, all tests indicated that sub-category variation was not significantly affected by problems of estimation and completion, nor did it significantly affect the issue rate. In other words, the differences in the effect of capital expenditure on the issue rate in later years of our period, did not result from the likelihood that inflation had less effect on furniture costs and equipment costs than on building and site costs, but rather from the large expenditure on uncompleted libraries, particularly large central libraries that were in the process of construction late in our period.

6.5. Summary and conclusions

These are provided in Chapter 10, 10.2. Conclusions 55 to 64

Table 44. Changes in Library Frequencies and in Library Frequencies adjusted per 100,000 population over the period 1969/70 to 1973/74

County	Positive and Negative Changes in the Frequency of Full-time Libraries	Positive and Negative Changes in the Frequency of Full-time Libraries adjusted per 100,000 population
Westmorland	2	0.42 (*)
Lincs. Lindsey & Holland	4	1.15
Isle of Wight	0	0.00
Hereford	-1	-0.17
Lincs. Kesteven	2	1.15
West Suffolk	1	0.18
Cumberland	0	0.42 (*)
Oxfordshire	1	0.19
Bedfordshire	3	0.51
Cambridgeshire	4	0.74
Yorks (N.R.)	1	0.18
Salop	-1	-0.28
Northampton	6	1.21
Dorset	1	0.18
Cornwall	14	3.52
East Sussex	4	0.61
Devon	1	0.11
Leicestershire	4	0.48
West Sussex	0	0.00
Norfolk	7	1.07
Berkshire	2	0.31
Wiltshire	6	1.18
Northumberland	3	1.04
Gloucestershire	1	0.21
Buckinghamshire	1	0.20
Somerset	3	0.50
Nottinghamshire	3	0.30
Derby	4	0.45
Staffordshire	4	0.40
Durham	1	0.16
Hertfordshire	2	0.21
Surrey	0	0.00
Hampshire	9	0.63
Cheshire	4	0.11
Essex	3	0.21
Kent	11	0.76
Lancashire	5	0.36
Mean	2.9	0.51
Standard Deviation	3.0	0.63
Coefficient of Variation	1.03	1.25

(*). Because of geographical access problems in the case of the two Cumbrian counties, i.e. the fact that there is proximity and joint access of some of the libraries to the populations of both counties their populations and the changes in their numbers of libraries are aggregated for the purpose of analysis.

Table 45. A Sample Frequency Distribution of English Libraries completed in 1969

Historical Cost Class Interval	Frequency	Relative Frequency (%)
Under £10,000	3	7
£10,000 & under £20,000	8	20
£20,000 " " £30,000	10	25
£30,000 " " £40,000	8	20
£40,000 " " £50,000	1	2
£50,000 " " £60,000	1	2
£60,000 " " £70,000	2	5
£70,000 " " £80,000	1	2
£80,000 " " £90,000	0	0
£90,000 " " £100,000	1	2
Over £100,000	6	15
Aggregates	41	100

Note

This table was constructed from a sample of capital estimates for library authorities, and includes a few rebuilding and extension projects. It differs from the data in New Library Buildings 1972, which itself contains only significant projects for 1969, but there is no significant difference in the frequency distribution.

Table 46. A joint sample frequency distribution of English libraries completed in 1970 and in 1971

Historical Cost Class Interval	Frequency	Relative Frequency (%)
Under £10,000	1	3
£10,000 and under £20,000	3	9
£20,000 " " £30,000	9	28
£30,000 " " £40,000	8	24
£40,000 " " £50,000	5	15
£50,000 and over	7	21
Aggregates	33	100

Note

As above, this table includes some cases of rebuilding involving extension.

Table 47. A Comparison of the sample frequency distribution of costs of English libraries completed between 1969 and 1971 with a simulated Poisson frequency distribution where λ = np = £28,500

Historical Cost Class Interval	Frequency	Relative Frequency	Nearest Poisson Approximation
Under £10,000	4	5.4	5.9
£10,000 & under £20,000	11	14.8	16.5
£20,000 " " £30,000	19	25.4	23.7
£30,000 " " £40,000	16	21.6	22.3
£40,000 " " £50,000	6	8.2	16.0
£50,000 " " £60,000	2	2.7	9.0
£60,000 " " £70,000	3	4.1	4.3
£70,000 " " £80,000	1	1.4	1.5
£80,000 " " £90,000	1	1.4	0.6
£90,000 " " £100,000	1	1.4	0.1
Over £100,000	10	13.6	0.1
Aggregate	74	100.0	100.0

Note

The reason for the 'peaked' nature of relative frequencies in comparison with the simulated Poisson approximation is explained in the text.

Table 48. A Comparison of the Sample Frequency Distribution of estimated costs of English projects in 1971 for 1972 forward with a simulated Poisson distribution λ= £85,000

Estimated Cost Class Interval	Frequency	Relative Frequency	Nearest Poisson Approximation
Under £50,000	2(2)	2(2.3)	19.3
£50,000 & under £100,000	49(46)	45(52.8)	30.1
£100,000 " " £150,000	22(18)	20(20.8)	26.4
£150,000 " " £200,000	8(8)	7(9.2)	15.0
£200,000 " " £250,000	8(5)	7(5.7)	6.3
£250,000 " " £300,000	2(2)	2(2.3)	2.1
£300,000 " " £350,000	5(3)	4(3.5)	0.7
£350,000 " " £400,000	3(2)	3(2.3)	0.1
Over £400,000	11(1)	10(1.1)	0.0
Aggregate	110(87)	100(100.0)	100.0

Note

Bracketed frequencies are non-central (branch etc) projects.

Chapter Seven. The Effect of Capital Expenditure on Mobile Libraries on the Rate of Issues per Capita

7.1. Introduction

In commercial accounting, mobile libraries would be treated as capital items, indicated on balance sheets as fixed assets and their values adjusted annually by mean of depreciation adjustments. In the case of library authorities, however, the treatment varies somewhat. Mobile library acquisitions, particularly replacements, are frequently funded from revenue expenditure by means of a mobile libraries fund. Consequently they may not appear in capital expenditure accounts of library authorities, nor in the capital expenditure statistics of county councils.

Yet, in theory they are capital expenditure. The report (93) of the Library Advisory Councils, Public Library Service Points suggests that they are the most appropriate means of servicing areas with populations of under 1,000 persons, following the suggestions of the earlier Boyle Report (93). Consequently, mobile library acquisition could be treated in the same way as branch library construction, were it not for the fact that running costs and depreciation have much higher ratios to acquisition costs than the ratio between the premises costs and depreciation of fixed service points and their costs of acquisition and construction.

The historical study of the trend in issues per head of population indicates that the episodic change of direction after 1950 may be attributable to the effect of mobile libraries on the issue statistic, though this is only one factor. We thus arrive at the need to investigate the effect of mobile libraries on the issue statistic, via three routes:

(i) the fact that expenditure on mobile libraries is capital expenditure in theory, providing the recommended appropriate service points for populations under 1,000;

(ii). the fact that some library authorities that witnessed large increases in the issue rate between 1970/71 (e.g. Cornwall) acquired and serviced mobile libraries that were charged to revenue (5.4(vi)); and
(iii) the hypothesised historical effect of mobile library acquisition on the change in the direction of the issue statistic after 1950 (2.4) but with a proposition (2.3(ii) footnote) that mobile library issues tend to tail off after the initial impact of acquisition.

From the standpoint of the criteria stated in chapter 1 for the conversion of issue statistics into estimates of social benefits, there is little difference between statistics of issues from mobile libraries and those from part-time branches. In both cases there are few non-book benefits, the differences in reference library facilities are immaterial and the main benefits are borrowing and browsing when the library is either open or available. In both cases, therefore, the minimum conversion rate should be employed for estimating the likely social income from the capital expenditure.

With these criteria in mind it is evident that the methodology of this chapter should be a modification of that used in the last chapter. Again, we should try to discover whether there is a general model relating mobile libraries to changes in the frequency of issues per head of population, but it is questionable whether in this case a test of correlation between changes in the frequency of mobile libraries and changes in issues per head of population is desirable, for such a test would not account for the renewal and replacement of mobile libraries. Whereas each building project is a 'one-off' expenditure not likely to entail further commitment for a large number of years, existing mobile libraries are likely to be renewed at intervals of under ten years. A simple calculation of changes in the frequency of mobile libraries per head of population between 1969/70 and 1973/74, as in the case of buildings, will not take account of such an effect. It is therefore more desirable that we should examine the general commitment of each county to mobile libraries (per head of population) and assess whether it is related to changes in the issues rate (per head of population) between 1970/71 and 1975/76. This treatment of the problem also takes account of the earlier statment that the proportion of maintenace cost to acquisition cost for mobile libraries tends to be greater than that of maintenance cost to construction cost for buildings.

Having constructed such a model associating the frequency of mobile libraries with that of changes in issues per head of population, we must then turn to examine cases where large investment in mobile libraries is apparently associated with small increases or decreases in issues per head of population. In turning from the general to the particular treatment of the subject we shall also examine an 'impact' effect, that a new mobile library tends to be first popular, and initially accelerate the issue rate, but that this acceleration reaches saturation point and then declines.

Thus the treatment given to the association between capital expenditure on mobile libraries in this chapter is a specific one. There is no space to deal with the economic arguments for mobile libraries to service the occupants of rural districts and large estates that were not constructed around natural (i.e. shopping etc.) centres, or with library arguments for advantages of fixed service points (e.g. reference, newspaper room and other 'browsing' facilities, or non-book activity advantages of a cultural, dramatic or artistic nature).

Instead, the proposal is that in 7.2. we attempt to construct a 'general' model associating the frequencies of mobile libraries per head of population with changes in the rate of issues per head of population. Before doing so, there must be an assessment of the limitations of such a model, because of:

(a) the weakness of using measurements per head of population for comparative purposes; and

(b) the abnormal frequency distribution of mobile library frequencies.

Having shown that there is, indeed, an association between the frequency of mobile libraries (per capita) and changes in the issues of authorities (per capita) it will be necessary to examine some of the exceptions in 7.3. We shall do so by examining:

(i) the effect of intra-authority variation in large counties, particularly those that do not appear to conform with the general model

(ii) the effect of mobile libraries in small library authorities prior to the 1972 Act.

It is stressed that this chapter cannot discuss the relative advantages of mobile libraries over fixed service points or contrasting disadvantages. Nor can we discuss the extent to which the recommendations of the Boyle and (93) Advisory Councils' reports (that mobile libraries service populations of under 1,000) were carried out. Both these questions were researched, but the research is peripheral and does not come within the terms of reference of this study.

7.2. A General Model associating the frequency of mobile library services per capita and changes in the issue rate

A discussion of the relationship between service units and issues must indicate:

(i) the modifications of the criteria in chapter 6 when applied to mobile libraries;

(ii) the limitations of statistics of mobile library frequencies expressed <u>per head of population</u>; and

(iii) a discussion of the non-linear association and correlation coefficients between frequencies of mobile libraries (per capita) and changes in the issue rate (per capita).

7.2(i). Criteria for studying the association between mobile library frequency and issues of books per capita

It has already been shown that, although mobile libraries are, in theory, capital expenditure, there is considerable practical justification in the existing treatment of separate funding from revenue because of the higher proportionate size of maintenance costs to acquisition (or construction) costs (in the case of buildings). Acquisition costs varied between £7,000 and £10,000 per unit early in the period, and unlike buildings where the mode increased from £20,000 to over £40,000 the acquisition cost of mobile libraries is small compared with that of subsequent maintenance and servicing, when compared with building costs.

Unlike buildings, where the frequency distribution of project costs is positively asymmetric, because of the effect of very high expenditures on central and headquarters projects, the frequency distribution of acquisition costs of mobile libraries is near-normal. We may therefore safely consider the effect of the frequency of mobile libraries on the issue statistic without spending, as we did with buildings, some time on the discussion of cost differences.

Further, because of the renewal and replacement factors little purpose is served by discussion of the correlation between changes in mobile library frequencies and changes in the rate of issues of books per head of population. Mobile library frequencies changed between 1969/70 and 1973/74 but these changes are not a true representation of mobile library acquisition and investment during the period, because of the renewal and replacement effects. In view of the relatively large annual spending on mobile library maintenance, it is statistically preferable to study the relationship between aggregate frequencies of mobile libraries per head of population and changes in the issue rate per head of population.

7.2(ii). The Limitations of the Proposed Analysis.

It has already been stated in 6.2. that there is poor correlation between mobile library frequency and population size. It was stated that, for 39 shire counties, the linear relationship between frequency of mobile libraries, population size, and the geographical size of county is best approximated by the equation:

$$F_4 = -0.116 + 7G_4 + 7P_4 + U$$

where:

the subscript 4 is the category, mobile libraries; and where:

F represents the frequency of service points, G represents a million-acre unit of geographical size and P represents a million-person unit of population.

Thus, any study of the frequency of mobile libraries per unit of population must consider the limitation imposed by greater measurability with geographical size than with population size. The correlation coefficient between population size and mobile library frequencies (0.531)is less than that between geographical size and mobile library frequency (0.671). This is, of course, expected since mobile library frequency should be a function of population sparsity rather than population density, the ideal usage of mobile libraries being by recommendations of the two reports (93) among populations of 1,000 or less.

To sharpen the parameters of discussion, we may perhaps additionally consider that for those counties whose populations are below the median (20th) of the 39 sample shire counties for England (i.e. Durham using 1975/76 statistics) the correlation coefficient between population size and mobile library frequency ($r = 0.286$) is not significant ($n = 19$) while the correlation coefficient between county acreage and frequency of mobile libraries is significant at both the 5% and 1% levels of significance ($r = 0.728$). For these small counties a standard of comparative measurement (mobile libraries per unit of county acreage) is more appropriate than one that is related to population size, but the appropriate regression equation for these counties

$$F_5 = 4.171 + 6G_5 + U;$$

where F is the frequency of mobile libraries for this particular set of 19 counties, and G the 1 million-acre unit of geographical size, is even more appropriate.

But it is useful to observe even at this stage, where measurement with county area seems theoretically more appropriate than measurement with population size, that the counties that show high frequencies using one standard of measurement are similar to those that have high frequencies measured by the other, so the distinctions that have been drawn are of theoretical interest.

Using the above regression equation with area of county as the only regressor variable, the counties that have significantly high frequencies are Bedfordshire, Herefordshire and Durham, that is, in these cases, there is significant difference between the regression estimates and the actual observations. Other relatively high frequencies, using regression errors as a test of measurement of comparative frequency are Cornwall, Somerset, Cumbria and Buckingham.

Yet this particular standard of measurement can only be applied to the mobile libraries of small counties. For the whole set of 39 shire counties included in our terms of study, the regression equation is as stated:

$$F_4 = -0.116 + 7G_4 + 7P_4 + U$$

and the frequencies of mobile libraries are therefore best measured by comparison with both population and geographical size. Partial F-values are 53.37 and 32.53.

For the purpose of comparison a table of counties with high regression errors, and with low regression errors is more important than a simple calculation of the statistics of mobile libraries per head of population.

Table 49 provides these details, and by comparison with the per capita frequencies of mobile libraries it will be seen that there are some important differences in the performance of counties, but some large variation because of the standards of measurement. Hertfordshire has a high investment in mobile libraries using the criterion of comparison with the regression equation, but does not appear as high on the table of 'per capita' frequencies.

For this reason we must proceed with caution, and when examining exceptional cases, ensure that we examine specifically those counties that appear to have very high mobile library investment using one or other of the criteria that have been established, and yet do not appear to have high increases in the rate of issues per head of population using index L. So, for the purpose of the general model (7.2(iii)) we intend using the simple measure, mobile libraries per 100,000 population, and we shall give preference to the results of a simple non-linear 2 x 2 category test, because of the rank differences between per capita values and regression errors from a linear model based on both population and area. This will help to prevent the problem of heteroscedasticity if a regression model is used and yet though the per capita test and that of 'error' from the linear estimates produce different ranks, the category performance of most counties is similar using either test.

In general, using a test of regression errors, Hertfordshire, Lincolnshire (Lindsey and Holland), Somerset, Devon, Durham, Surrey, Northampton, Cornwall, Cumbria (both Cumberland and Westmorland), Warwick, Buckingham, North Yorkshire, Avon and Staffordshire are in the high mobile library investment category using the test of regression error, and, for example, Cambridgeshire, Dorset, Cleveland, West Sussex, Leicestershire, Humberside, Derby, Kent, Gloucestershire, East Sussex, Essex, Suffolk and Berkshire are in the low mobile investment category, not because of underinvestment, but because, for example, Essex compensates with very high branch library investment.

7.2.(iii). A Study of Association between relative mobile library frequencies and relative changes in the issue rate

An examination of Tables 49 and 50 will show that counties are ranked differently using (i) simple per capita mobile frequency and (ii) mobile frequency judged by regression on (a) population and (b) area, but that most are in similar high/low categories with few exceptions, Hertfordshire and Gloucestershire. Thus we propose an hypothesis of association between the relative frequency of mobile libraries and relative changes in the issues of books per head of population. It must now become one of non-linear association between the relative frequency of mobile libraries and changes in the issues of books per head of population. It will become more evident as we proceed, that a hypothesis of rank correlation is weak because of the two different ranks of counties using both criteria proposed in 7.2(ii), and, as we shall show, the prospect of Pearson correlation is hampered by the abnormal frequency distribution of mobile library frequencies. We can, however, for the purpose of illustration, calculate the results of (i) a median test of category association using Fisher's test; (ii) the Spearman correlation coefficient; and (iii) the Pearson correlation coefficient.

For the purpose of a 'per capita' study I decided to use a conversion expressing the frequency of mobile libraries to 100,000 unit of population. This was preferable to the use of a million unit measurement of population, because it enabled mobile library frequencies to be converted to three-digit measurements of relative frequency without excess of zeros or decimal places.

Expressed in units per 100,000 of population the range of mobile library relative frequency measurement per unit spanned the limits of the range 0.35 for Essex (i.e. 5 mobile libraries divided by a population factor 14.2 representing the population in 100,000 units of Essex and those districts that were incorporated into Essex after the 1972 Act) to 3.75 for Somerset (representing 15 mobile libraries controlled by the Somerset library authority, divided by the appropriate 100,000 unit population factor).

It should already be apparent that the rank differences of relative frequency are different using both criteria. A glance at the Table (49) will show that Bedfordshire and Buckinghamshire are the two 'extreme' cases using regression criteria. Thus, it is advisable that

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a non-linear, non-parametric category test of association be used. This must be a modification of the 'median test' using Fisher's exact 2 x 2 probability test of association. As the analysis concerns two different variables, it is necessary to use the medians of each variable for the purpose of categorising (i) high and (ii) low relative frequency of mobile libraries and (i) high and (ii) low rates of change in the issue statistic per head of population. For the purpose of category classification of relative frequency of mobile libraries, for example, the median is Surrey which has a measurement of 1.2, that is 12 mobile libraries and one million people (i.e. 10k, where k =100,000). Using index L as a basis for the measurement of change, but modifying with index J where it can be shown that issues for 1974/75 and 1975/76 are substantially different from each other, the Fisher test of association between relative frequencies of mobile libraries and relative changes in the issue rate can give a result from a 2 x 2 division of the data of a = 14, b = 4, c = 4 and d = 14. There is no significant difference if the counties are categorised using the more exact standard of measurement, that of difference between expected and observed frequencies using the regression equation. Gloucestershire has a mobile library relative frequency higher than the 1.2 median but is in the lower category using the other standard of measurement so the results from this more 'exact' method of relative measurement are statistically less significant. However, a Fisher's test performance with the above array a = 14, b = 4, c = 4 and d = 14 lies (P = 0.0014) beyond the 5% and the 1% levels of significance so that the hypothesis that there is no association between relative frequencies of mobile libraries and relative rates of change in the issue statistic can be rejected at the 1% level of significance, and some association postulated. Even if regression errors are used to rank the relative frequency of mobile libraries using the criteria of both population and geographical area there is still some association but it is less significant.

The test of using rank variables suffers the disadvantage that the relative frequency of mobile libraries may be ranked differently using the criteria explained earlier (i) per head of population and (ii) using differences from regression estimates based on both area and population. If we use index L, however, the association between the frequency of mobile libraries per 100,000 unit of population and the positive changes in the issue statistic is no greater than a rank correlation coefficient of 0.39. This indicates some association but is not significant at either the 5% or the 1% levels of significance, though it does not take into account some extreme values.

The uses of ordinary Pearson correlation coefficients between mobile library frequencies per 100,000 unit of population and indices J and L do not produce significant results, and the test would, in any case, be weak because of the asymmetry of some extreme cases (Lincolnshire, Kesteven 2.887), but interestingly both correlation coefficients (0.28 and 0.24) are positive but not significant. The best association in this case is produced by index M, the 'ideal' index used in chapter 5, but this is not significant at the 1% level of significance. Indices I and K produce correlation coefficients as low as 0.207 and 0.049.

Thus, we may conclude 7.2. by stating that there is an association between the measurement of the relative frequency of mobile libraries and that of changes in issues of books per head of population, but that this association is a non-linear one, stemming from a simple chi-squared division of the data into two 'equal' frequency categories using variate medians for the purpose of 2 x 2 category division. It cannot therefore be postulated that mobile library investment has a linear effect in changing the rate of issues of books per head of population.

7.3. A Study of Intra-County Variation.

As in the case of chapter 6 we now move from the general to the particular, and it is desirable because of shortage of space in reporting research that we confine consideration of particular cases to examples of exceptions to the associative non-linear model that was propounded in 7.2. associating high investment in mobile libraries per capita with high positive changes in the issue rate per capita and vice versa. Thus, we propose selecting two counties that appeared to have high library investment using either of the criteria proposed in 7.2. for relative measurement, then looking at a third comparable case of a third county outside the immediate sample used for the general model (a Welsh county) where there appear to be a contradiction of the general hypothesis. In the cases of all three counties it will be shown that mobile libraries contribute significantly to the rate of issues per head of population.

In the second part of this section of the chapter I move from intra-county comparison to a selection of smaller library authorities pre-existing the 1972 Act. It is shown in all these cases, that there is an 'impact' effect of mobile libraries, that where they are introduced, the initial effect is a very high rate of borrowing, but that there is often a tailing off of enthusiasm, leading to a more normal pattern. Thus, the effect on a particular area not only depends on the time of acquisition of the library but on its use in a given locality.

In all cases, for the purpose of 7.3. I move from secondary data to primary data obtained specifically from the county librarian or library authority for the specific study of these apparently exceptional cases. As some of the more detailed information was not intended for publication, I use the descriptions counties A, B and C.

County A was particularly investigated because it appeared, that despite the very high commitment to mobile libraries, there was a decline in the issue statistic using indices I, J and L. For the purpose of correlation in chapter 5 it was assumed that, although the issues of 1969/70 could be of an atypical nature because of the surviving practice of a very few counties to include school issues in their aggregate statistics, this atypical pattern had been rectified by 1970/71. It should be stated that the Municipal Yearbook statistics aggregate recorded issues without reference to the question whether school issues are recorded or not. In general most libraries had conformed with the convention to exclude school issues by the 1970/71 statistics published in 1972. Further, as the difference resulting from inclusion is sometimes not more than 2 or 3 issues per head of population, in the absence of primary data to the contrary, the indices for county A were calculated on the assumption that school issues were excluded. Primary data obtainable from the county librarian showed that this was incorrect, and although the difference amounted to only 3 issues per head of population, there was, from the correction of the school issues factor from primary data a revised index L of 1.09, and an even greater association between mobile library frequency and the progress of the issue statistic.

Needless to say, in the correlation study of chapter five allowance had already been made for the inclusion of associated borough and district authorities.

Table 51 provides a self-explanatory table of data for County A for the years 1968/69 to 1973/74. It can be seen that though n = 6, using the t-test, the difference between mobile issues per book of bookstock and branch issues per book of bookstock is significant at the 1% level. There is no doubt that, in this case, mobile libraries made a far more effective use of bookstocks than did branch libraries. The case is sharpened by the fact that, in this case, not only was each book of effective mobile library bookstock issued more than twice as frequently as each book of effective branch bookstock, but that mobile library bookstock was only 33% of effective branch bookstock and less than

16% of the total bookstock of the county. Table 52 gives the comparison between mobile issues per reader and branch issues per reader for this county, and using observation of n years, where n = 6, the t-test statistic again indicates that the difference between mobile and branch issues per reader is significant at the 1% level of significance.

It is suggested that if we apply the minimum conversion rate for the estimation of social income from mobile libraries, and a higher rate for branch libraries to account for the better 'browsing' and possibly reading and reference facilities provided by branch libraries vis-a-vis mobile libraries, the position is none-the-less one that is very favourable to mobile libraries. Hence, even in this exceptional county it is seen that mobile libraries made a high positive contribution to the aggregate issue statistic. In fact, one-fourth of the non-school issues of the county were generated by its fleet of mobile libraries. Table 53 provides 'income' estimates.

The unique inclusion of school issues late in the period has partly explained why a county with almost the highest relative frequency of mobile libraries expressed per capita appeared to decline in the issue statistic by index L, for index L can, in this unique case, be revised to 1.09. Yet the increase of issues is only 9% and with such a high commitment to mobile libraries one would expect this to be higher. A return to Table 51 explains why this is so. In fact the issues (by comparison with Table 52) are seen to have increased to a 'peak' in 1971/72 and then begun to tail downwards representing 'acceptance' by a public of a mobile library service, and consequent diminishing of enthusiasm. This phenomenon has been observed in other counties studied. The question whether mobile libraries can ever be permanent substitutes for branch libraries can be answered from a consideration of this information. Issues from mobile libraries are relatively higher than from branch libraries, but this may be temporary, and result from 'impulse' borrowing when a mobile library is available. This may not be a permanent phenomenon.

County A was a notable case of high relative mobile library investment using the simple criterion of judging mobile library frequency per 100,000 unit of population. It was seen that the apparently poor performance under three of the proposed indices of change in the 'per capita' issue statistic could be explained by other factors, such as the high pre-existing level of mobile library investment and the exceptional nature of reporting (i.e. the inclusion of schools issues as late as 1970/71), but that mobile library investment accounted for a relatively large component of the statistic, issues per capita.

The case of County B is similar, but for this purpose I use the case of a county whose performance in terms of relative mobile library investment was high using a regression error from an expected value based on population and area. The county, despite high mobile library investment, appeared to show a declining pattern of issues per capita using the criteria of indices I,J,K and L. Several factors accounted for the paradox in the case of county B:
(i) the county had a very high rate of mobile library investment at the beginning of the period;
(ii) the rate of issues of books per head of population was also much higher than the mode for England and Wales. It was 13.6 at the beginning of the period and 13.4 at the end of the period, and although there had been a much greater apparent decline because (a) the county had absorbed several districts after the 1972 Act, and (b) schools issues were included in 1969/70 statistics but not in 1970/71, the level of issue frequency per head of population was both good and stable;
(iii) there was even further evidence of a saturation effect of mobile libraries, that after some years of initial impact and usage, the level of issues per item of bookstock or per member of a mobile library tends to decline slowly; and
(iv) despite the saturation effect, the comparative level of issues from mobile libraries was much better than that from its branch libraries.

These exceptional cases constitute a relatively small proportion of our 'central' sample of 39 counties. The non-linear 2 x 2 category test of association between high and low mobile library investment per capita and high and low progress of the issue statistic indicated significant association, but the explanation of the exceptions to the category test are speculative unless they are supported from other data. To do so, we have to move outside our sample of 39 English counties.

County C is the best illustration of apparent decline from high 1969/70 to low 1970/71 rates of issues per head of population despite high mobile library investment. As it was not included in the 39-county sample because of the earlier problem (chapters 5 and 6) of high capital investment (buildings) but small population, it is necessary to provide a few preliminary details. It is a Welsh county whose published issue statistics were 16.6 per head of population in both 1968/69 and 1969/70, but its published issue statistics were reduced to 13.1 in 1970/71 because school issues were not reported. If they had been calculated and included in correlation with capital investment, the effect of disparity between the years would have been distortive. The effect of adjustment for this county was to show increases under I,J,K and L, in respect of issues per head of population, despite an index distortion of 0.79 (i.e. 13.1/16.6) between these two years. Further, like County B this county's rates of issues per head of population were significantly higher than that for the United Kingdom generally.

Again, the inter-year paradox can be explained because
(i) the county had a higher pre-existing rate of mobile library investment and of issues per head of population than that of the mean for all counties;
(ii) apparent inter-period distortion resulted from non-inclusion of schools issues; and
(iii) despite a saturation effect the comparative level of issues from mobile libraries exceeded that from branch libraries.

Proposition (iii) is supported by Table 54, and the evidence of the saturation effect is again available, for the statistics of issues per reader from mobile libraries fell significantly from 69.76 in 1970/71 to 54.77 in 1972/73 in spite of the better ratio of issues per book for later years. This could, of course, be attributable to smaller increase in mobile library bookstock proportionate to branch library bookstock. The county lay outside the general set of 39 counties intended to test the general hypothesis of association, but adjusted statistics for this county are generally supportive. Its composition was radically altered after the 1972 Act, and thus detailed primary data require considerable readjustment for comparison between the data for old and new county areas, and is not relevant to proof of the explanations given for counties A and B. It is already seen that, though outside the 39 county set, County C provides a similar case for explanation of exceptions A and B. Further, County C provides an interesting insight into the mechanism of the 'saturation' effect in mobile libraries. Mobile issues (see Table 54) did, in fact, increase by about 7% between 1970/71 and 1972/73 but mobile library readers increased by nearly 60%. Thus, the enthusiasm generated by the mobile libraries pre-existed the period in impact. The additional mobile library tickets were issued to less enthusiastic readers, or alternatively the borrowing patterns of the existing readers declined.

For counties A and C, using the minimum rates of conversion of issue statistics to estimates of social benefit, the highest rate of investment was attributable to mobile libraries. In the case of county A 11 mobile libraries were responsible for one third of the county's issues, a capital cost of under £200,000 obtaining, even without associated benefits, and at a conversion rate of 40p per issue an estimated benefit of £400,000, but reducing to £150,000 (yet an annual return of investment of 75%) when associated costs (revenue) of mobile library servicing, staffing and maintenance were deducted.

County C followed a similar pattern. In this case 7 mobile libraries costing over £100,000 produced a gross return on investment of £120,000 using a 40p conversion rate for estimation of social benefit from issue statistics (chapter 1), but again the actual return on investment reduced to 57% when maintenance and associated costs were deducted.

From a study of intra-county variation to a study of specific cases using primary data, similar features could be discerned in every case examined. Even the purchase of single mobile libraries verified the conclusions of the earlier sections of this chapter. For example, Barry Borough Council acquired a mobile library prior to its termination of library authority status under the 1972 Act. Its issues contemporarily increased from 588,858 (13.87 for 42450 people) in 1970/71 to 653,090 (15.59 for 41,910 people) in 1972/73. The increase was partly attributable to the closure of the library for alterations in 1970/71, but even with the correction of these statistics, the 1970/71 data would stand maximally at 600,000. Thus, 53,000 issues were attributable to the purchase of a mobile library. Using a conversion rate of 40p this represents a return on investment of over 100%, but correction for inflation in this case (i.e. a reduction of our estimate to 20p for 1970/71) will still provide a net return on investment of 35% per annum.

A second case examined was Luton prior to its incorporation into Bedfordshire. Again, not only was the rate of issues per member (mobile libraries) at between 50 and 60 per annum, a case comparable with the three counties studied, and with Barry, but there was evidence of the saturation effect, that of a small decline in mobile libraries' issues per member after a few years of service. Over fifteen other single mobile libraries were examined and there was, in every case, confirmation of the hypothesis stated, that mobile libraries produce a significantly larger return on investment (estimated from issues per member, even at the minimum conversion rates to allow for lack of associated benefits) than do fixed service points, but that the rate of return on investment tends to decline over time, when a population has been 'saturated' with the effect of mobile libraries, while that of branch libraries is more stable. In one outstanding case, that of a county borough library that was incorporated into Gloucestershire after the 1972 Act, a mobile library serviced 1970 readers with 120,900 issues, a rate of issues per member of 61.37.

Before concluding, I must make one small qualification to statements about the 'saturation effect' of mobile libraries. It has been argued, particularly from the data of County C, that initial membership 'appeared' more enthusiastic from borrowing statistics, than did later 'subsequent' membership, for an increased membership of 60% produced an increase of only 7% in aggregate issues of books. There is a part-explanation that, in the earlier years of a mobile library, there may be joint usage of a single ticket, joint users later becoming so satisfied with membership that they become (as previous users of other people's tickets) personally registered members for the purpose of added convenience. But this does not contradict the 'saturation effect': it simply explains it. It is nonetheless true that when a library system has been serviced by mobile libraries for a number of years it reaches a 'peak' of issuing, from which subsequent decline is both evident and inevitable.

7.4. Summary and Conclusions

These are provided in Chapter 10, 10.2. Conclusions 65 to 70

Table 49. Some typical positive and negative regression errors between estimates and actual mobile frequencies

County	Positive Error	County	Negative Error
Hertford	4.3 *	Gloucester	3.1 *
Cornwall	2.1	East Sussex	5.8
Somerset	3.1	Essex	2.6
Durham	3.4	Suffolk	3.7
Surrey	3.9	Berkshire	4.9

Note
The above are typical cases. Generally, positive error counties correspond to those whose mobile investment per 100,000 is greater than 1.2, and negative error counties to those whose mobile library investment is less than 1.2

Table 50. Mobile library frequencies, using the mean for the period 1969/70 to 1973/74 expressed absolutely and relatively

County	Absolute Frequency	Frequency per 100,000 people
Westmorland	3	1.89 (as Cumbria)
Lincoln(L & H)	12	3.20
Isle of Wight	1	0.90
Hereford	5	0.85
Lincoln (Kest)	3	2.60
W. Suffolk	3	0.53
Cumberland	6	1.89 (as Cumbria)
Oxfordshire	7	1.30
Bedfordshire	5	1.03
Cambridge	4	0.74
Yorkshire (NR)	8	1.41
Salop	6	1.69
Northampton	6	1.21
Dorset	4	0.70
Cornwall	9	2.27
East Sussex	-	0.00
Devon	14	1.51
Leicestershire	7	0.84
W. Sussex	7	1.13
Norfolk	11	1.69
Berkshire	5	0.76
Wiltshire	7	1.38
Northumberland	10	3.49
Gloucester	6	1.24
Buckingham	8	1.61
Somerset	15	3.75
Nottingham	6	0.61
Derby	10	1.12
Staffordshire	11	1.11
Durham	12	1.96
Hertfordshire	10	1.06
Surrey	12	1.20
Hampshire	14	0.97
Cheshire	9	1.00
Essex	5	0.35
Kent	9	0.62
Lancashire	13	0.95

As mobile libraries largely serve rural areas, the pre-redistribution populations were used as a population base. Frequencies are those before reorganisation

* Hertfordshire and Gloucestershire are shown at the head of Table 49 as exceptional cases. See text.

Table 51. Relevant Comparative Statistics - Mobiles and Branch Libraries for County A (pre-redistribution)

Year	Issues per Capita (ex schools)	Issues per Book of all Bookstock	Mobile Issues per book of Bookstock	Branch Issues per book of Bookstock
1968/69	10.45	6.37	16.24	7.91
1969/70	10.12	5.79	15.70	7.09
1970/71	10.69	5.83	16.65	6.96
1971/72	10.87	6.19	16.72	7.69
1972/73	10.75	5.78	16.67	7.03
1973/74	11.02	6.11	16.98	7.11

Table 52. Comparative Issues per Reader Statistics showing differences between mobiles and branches County A

Year	Mobile Issues per Reader	Branch Issues per Reader
1968/69	43.25	32.25
1969/70	39.95	31.22
1970/71	44.64	30.36
1971/72	40.73	29.18
1972/73	38.76	28.88
1973/74	39.71	29.04

Table 53. Comparative Estimates of Minimum Social Benefit for County A using adjusted values for inflation, and the range 15p to 40p for mobiles, but 20p to 50p for branches

Year	Branch Issues	Estimated minim. Social Benefits at the 95% confidence level	Mobile Issues	Estimated minimum Social Benefits at the 95% confidence level
1968/69	2129813	£425963 (20)	1424362	£213654 (15)
1969/70	2113235	£528309 (25)	1369716	£273943 (20)
1970/71	2254292	£676287 (30)	1434560	£358640 (25)
1971/72	2390697	£956279 (40)	1446135	£433841 (30)
1972/73	2463931	£1231965 (50)	1366482	£546593 (40)

Note Bracketed values are conversion values, in pence. Following the precedents of chapter one, more conservative estimates have been made for mobile libraries because of the lack of associated benefit facilities (reference etc.) Early values agreed with those provided from primary data in research carried out for the previous thesis (6). The mobile 'gross income' derives from an investment of under £200,000

Table 54. Comparable Statistics County C.

Statistic	1970/71	1971/72	1972/73
Total Issues (ex school)	1777581	1827512	1895662
Issues per capita (")	12.99	13.00	13.24
Mobile Issues	369729	398235	450538
Mobile Bookstock	35404	33766	36518
Mobile Issues per Book	10.44	11.79	12.34
Mobile Readers	5300	5720	8225
Mobile Issues per Reader	69.76	69.62	54.78
Branch Issues per Reader	30.23	29.47	29.36

Chapter Eight. The Effect of Capital Expenditure on Bookstocks on the Rate of Issues per Head of Population

8.1. Introduction

This chapter and chapter nine discuss two other possible candidates for the category, capital expenditure. Bookstocks are considered in this chapter, and human resources in chapter nine. Bookstocks require consideration as a 'grey area' that cannot be clearly categorised as capital expenditure because of the very different patterns of usage in differing libraries, and the question is necessarily one of extent rather than of clear category. Section 8.2. commences with a review of the existing treatment of expenditure on initial bookstocks by library committees. This is followed with a discussion of treatment by analogy with commercial accounting, questioning whether all book costs can be compared with the 'direct material' inputs into an end-product (analogous with issue-benefits) or whether alternatively, because of its heterogeneous composition, an existing bookstock should be regarded as a capital unit, with natural wastage, (depreciation) and replenishment. These two analogies are used to polarise discussion.

Section 8.2. will continue by providing three sets of studies to illustrate the extent to which either the 'direct material' model (revenue) or the single unit model (capital) may be applicable in the conditions of a given library. First, to illustrate the 'capital' view of bookstock, I provide the case of an archive collection where usage is not a function of the time that has elapsed since the date of acquisition. Secondly, I recount my own 'date-label' analysis studies in five representative libraries where the 'Browne' method of ticket-charging was employed, and where the usage patterns of all classes and subject-categories of books could be studied over a number of years. It is shown that the pattern of usage is, in all cases, highly skewed over time, and that the ideal 'archive-type' model of a library bookstock as a unified capital asset (with linear depreciation over time) cannot be applied to the circumstances of public libraries without some modification. A third set of studies is then provided as corroborative illustration. They were undertaken contemporaneously with mine by (93g) Buckland, and by Urquhart and Urquhart. Though their objective was different, for they were undertaken to assess the time-point at which academic bookstocks should be relegated (i.e. taken from shelves to store) they are relevant to the present thesis for they confirm a usage pattern in academic libraries similar to the borrowing pattern discernible in my own sample studies (i.e. skewed in negative binomial fashion over time).

Section 8.2. closes by concluding that since (i) books are heterogeneous the 'revenue' treatment of expenditure on books (by analogy with direct material in commercial production) can only be argued from pragmatic rather than theoretical considerations, but that since (ii) the usage of bookstocks is non-linear with respect to time, there is no case for arguing the composite (capital asset) view of a bookstock with linear depreciation with respect to average 'life' (seven to ten years), and therefore (iii) the optimal position is to regard a bookstock as a composite capital asset with high usage-obsolesence.

Thus expenditure on bookstocks is distinguishable from other expenditure normally designated as 'revenue' in library authorities' accounts, not only because there is much greater correlation between expenditure on books and issues than between other headings of revenue expenditure and issues, (as was indicated in chapter two) but because it is correctly non-revenue in nature, and theoretically, expenditure on a rapidly-changing (and quickly obsolete) capital asset. With this theoretical

(93g). Buckland's study was earlier, but part-contemporary; while that of Urquhart and Urquhart was published in 1976.

modification of the treatment of expenditure on books, the high positive correlation between expenditure on bookstocks and the issues of books is contributory evidence that capital (rather than revenue) expenditure affects the rate of issues of books from libraries.

Yet, it is inappropriate to argue from simple correlation between the two variables because of the circular nature of such an argument. It can, for example, be argued that expenditure on books must necessarily be greater in those areas where issues are higher, because demand has to be matched. Section 8.3. recounts the arguments of the previous thesis (6) with respect to the expenditures of the 32 London boroughs between 1966/67 and 1971/72. It is shown that there are positive correlations between increases in expenditures on bookstocks (adjusted for inflation) and increases in the issues of books, but that these are lagged over time. I then review other results which I published in Library Review some years after the presentation of the thesis (12) indicating that the same pattern was discernible for later years. The results of both these studies are re-interpreted to show that 'normal' expenditure on bookstocks has no more than an updating 'maintenance' function but that increasing expenditure on bookstocks may contain an element of capitalization, and its correlation with increases in the issue rate (lagged over time) would therefore enter the same category as earlier correlation between, for example, capital expenditure on buildings and increases in the rate of issues of books.

In Section 8.4. I discuss some of the later studies using London data that indicated that there are differing applications of the theory in different areas and to different readerships. Some of the evidence obtained from re-appraisal of the data is also discussed.

In Section 8.5. I return to the set of 39 counties that are considered in chapters 5, 6 and 7, and question whether the discoveries that were made in respect of London can be evidenced from the particular set of data used earlier in this thesis. This involves considering whether the increases in the annual amounts of expenditure of county library authorities on books per unit of population has a positive correlation with any of the increase indices proposed earlier in the thesis, particularly index L, because of its reliability.

Finally, Section 8.6. summarises the results of the research described in this chapter and assesses their importance in the context of the capital expenditure on libraries, generally.

8.2. The Cases for Capital and Revenue Treatments.

Bookstocks are the raison d'être of library systems. Though they cost proportionately less than other capital items, notably sites, buildings, computer equipment and some of the more expensive furniture, yet none of these other items can be designated library capital in the absence of a bookstock.
In theory, all expenditure on library bookstocks can be regarded as capital expenditure because the library is the bookstock.

In contrast to this simple theoretical statement, most expenditures on library bookstocks are, in fact, charged to revenue expenditure accounts. This takes into account the fact that most books have relatively short lives, that paperback novels, cheap periodicals and newspapers are often quickly relegated, and that even the more permanent fiction and non-fiction works become quickly dated. In short, the regular renewal, replacement and improvement of library bookstocks is so large in comparison with initial cost, that theoretical matters are not normally considered in library accounting. Library bookstocks are charged to revenue, because convention dictates that they should be.

An additional reason for this standardization of treatment is that comparative statistics may be obtained. Guidelines of 'per capita' expenditure on books appeared in the reports of the Roberts and other committees, and the consequent need to provide statistics for inter-system comparison prevailed over the more academic considerations of apportionment of book expenditure between capital and revenue.

Not that there is necessarily an attempt to adhere to a standard. For example, in the year before the commencement of our period (1968/69) the expenditure on books per head of population ranged in London alone between 17.7p (Croydon) and 55.6p (Westminster), the distribution of values being slightly asymmetric, the median (28.8p) falling below the mean (29.5p). In this consideration I exclude the artificially high value (£15.33p) for the City of London, for it is based on the number of residents rather than user population. This lack of standardization in expenditure is exacerbated outside London, and is reflected in low values of 9p per head of population for Bradford and Salford, and 8.5p for Milnrow U.D.C., and high values of 42p. (Epsom and Ewell) and 52.5p (Llandudno). There is no greater standardization at the end of the period of research for the estimates for 1975/76 show variability for London between 40.9p (Havering) and £1.37p (Westminster), with the median and mode located at 63p. while the variability is comparable in areas outside London, ranging from 12.8p (Buckinghamshire) to 57.8 (Tameside). Although inter-year comparisons show that in some cases sequential years' expenditures on books are compensating, there is much more evidence of inter-year correlation, viz. that authorities with stringent expenditures on books tend to remain so over time, and that those whose expenditures on books are generous also tend to remain so.

Most of this expenditure (i.e. in almost all cases, <u>all</u> expenditure on books) is charged to revenue so that it can easily be identified as such. Yet a search of the revenue and capital estimates of library authorities indicates that, in some cases, where the expenditure on books is of an abnormal or exceptional nature, there may be a charge to revenue. For example, Wiltshire County Council's Capital Budget 1975-76 and Forward Capital Programme 1976-77 and 1977-78 indicate that the initial bookstock for Salisbury Divisional Library should be financed from the Loan/Capital Fund in two stages, £10,000 in 1975-76 and £5,000 in 1976-77. This particular case involves the provision of a bookstock for a Central Library. Branch libraries are usually furnished from existing stocks, and the treatment of initial bookstocks is not uniform. The expenditure proposed for the bookstock of Newport Central Library (Isle of Wight) is represented by a capital payment of £17,000 for 1979/80. Scunthorpe's estimates in 1970/71 included capital provision for both furniture and bookstocks, and the Borough of Sutton Coldfield included in its Capital Expenditure Estimates for 1972/73 and 1973/74 amounts totalling £25,000 and £14,500 respectively for the initial bookstocks at the New Central and Wylde Green libraries. But, on the other hand, the Metropolitan Borough of Bolton designated part of a new record library collection to be partly funded from revenue. Further, many of the capital accounts for larger libraries do not contain debits for bookstocks. For example, the values provided by the Derbyshire County Librarian were exclusive of bookstocks, and in the cases of some large central libraries (for example, Birmingham) bookstock charges are either (i) not included or (ii) included and chargeable to revenue.

There are several reasons for the lack of standardised treatment. The bookstocks of small branches can, very frequently, be made up from existing branch stocks and reserves. Even the larger central libraries may be in a position to adopt an existing stock, particularly when a pre-existing library has been rebuilt. In recent years it has been easier to obtain funds from revenue rather than from capital sources because of capital expenditure stringencies. Where the amounts involved are small, the cost of an initial bookstock has frequently been included in the total library cost, or omitted and funded from revenue, but where the charge is larger it is frequently included with a comment that it is funded from revenue, particularly where there is some difficulty in the increase of borrowing, but the charge can be imposed on the rates.

Thus, the review of existing practice for the past 10 years shows that the allocation of bookstock charges between capital and revenue is often one of expediency and convenience. They are usually charged to revenue, but initial bookstocks may be charged to capital, though such charges are small compared with the total annual debits for the systems concerned. An initial bookstock for a small library will cost about £20,000, but the annual revenue bookstock charges of library systems in the United Kingdom vary between £50,000 and £500,000, and each capital bookstock payment is matched by an annual revenue effect 20% of its size. The annual aggregate capital debit for bookstocks for the United Kingdom never exceeds £300,000 quite irrespective of the way in which it is charged, while the annual revenue debit for bookfunds for the United Kingdom varied between £10,000,000 and £18,000,000 during the years that we are considering. The allocation of bookstock charges to capital is therefore less than 5% and not significant. The treatment of bookstock expenditure by library authorities is essentially a 'revenue' one.

8.2(i). Contrasting theoretical models

It has been seen that local government finance practice tends to make the allocation of bookstock expenditure between capital and revenue one of expediency. Bookstocks have to be replenished and improved annually. A large proportion is, at any one time, in the hands of borrowers from whom some may not even be returned. Even commercial accounting practice would normally dictate that, in such circumstances, a capital asset be written down over a short period. In public accounting the process can be short-circuited, and there is no need for debits to a capital bookstock fund to be matched by equivalent credits for the 'wear and tear' of existing books. The justification for a revenue treatment of bookstocks is pragmatic, but it is interesting that the very treatment has paved the way for an alternative theory of library book expenditure, particularly when standard costing has been applied to library expenditure. In a paper on the Standard Costing of Information Systems (94) Robertson, Reynolds and Wilkin argue the case for analogy between the classification of direct material, direct labour and overhead in industry and that of books and documents, library salaries and overhead expenditure in library budgets. If the analogy is pursued, books are the 'raw material' of 'library production' while 'loans' are the 'sales quantity' or 'sales revenue'. Each book is thus a revenue item because it is an input into 'work in progress' of which (i) library loans and (ii) other book usage are analogous to production.

The analogy is defective because of the nature of library bookstock. The 'direct material' inputs into commercial production are usually either homogeneous or standardized. It is the raison d'être of a library bookstock that it should be heterogeneous, i.e. that there should be as large a variety of titles as possible. Further, the 'revenue' model of library bookstocks is unsubstantiated by the length of life of a typical book. Many remain on shelves for as much as ten years, and individual books even longer.

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(94). S.E.Robertson, R. Reynolds and A.P.Wilkin: Standard Costing for Information Systems - the Background to a Current Study (ASLIB Proceedings 22.9. September 1970, pp. 452 - 457).

The contrasting model is that the whole bookstock be regarded as a composite capital unit. This is consistent with the view of the Bourdillon Committee and subsequent statements of library objectives that (95) the system be developed as a national asset and that (96) there be a well-balanced distribution of titles. Because the system requires to be heterogeneous in composition by its very objectives, and because each title could be a permanent acquisition there is less analogy with the inventory or 'work-in-progress' of a commercial firm than there is with a complex 'single-unit' capital asset (e.g. a computer where all records are essential because of their very difference in information content).

8.2(ii). The case for variable allocation

These two models, that of bookstock as revenue-funded 'work-in-progress' and that of bookstock as a large heterogeneous 'single-unit' composite capital asset, both tend to polarise the position. Though it would appear that, in theory, each book-acquisition is an addition to a permanent expanding capital unit, the viability of the theoretical model is bounded by obsolesence, usage and wastage. To illustrate optimal theoretical allocation between capital and revenue, I provide three examples:

(i) a hypothetical example where the 'capital' model would apply;

(ii) the results of sample studies in five different public libraries, indicating the pattern of usage; and

(iii) the results of other, but similar, studies carried out in academic libraries.

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95. Committee under H.T. Bourdillon, C.M.G.: Standards of Public Library Service in England and Wales (H.M.S.O. 20 September 1962) para 11-12.

96. Op cit para 16.

The hypothetical example that would best suit the capital model is that of a non-lending library containing books of a rare antiquarian character, where usage is not a function of recency. Because of (i) preservation, (ii) non-lending and (iii) the non-correlation of usage with time each acquisition could truly be regarded as the addition of a unit to a permanent, non-depreciating capital asset.

These hypothetical conditions must be relaxed when constructing a model for public libraries because of the nature of wastage, quite apart from usage. Specific studies of primary data for Cardiff, Bristol, Luton, Southend and Havering for the years 1969/70 to 1973/74 showed that bookstocks have a 'life' of between seven and ten years, apart from relegation. Most systems' bookstocks expand to a point of saturation and then titles are relegated on a 'date-label' basis. More generally, available secondary data showed some difference in bookstock 'lives' for each system. In non-county boroughs the annual quantity turnover from 1970/71 to 1973/74 was between 11% and 14% of existing stock while for urban districts the value was nearer 14%, and 12½% for counties and for London boroughs. As acquisition implies relegation even with some expansion we can, from this source, also infer that a book has a 'shelf' life of under 10 years. There are exceptions. I came across a work on patristics at the Central Library, The Hayes, Cardiff, that had been acquired in 1925, and (96a) dated-stamped only twice in thirty years. In general shelf-life is much shorter. But even a ten year life relaxes, but does not contradict, the 'capital' model. Many industrial machines have equivalent lives, and are treated by means of a depreciation debit. Why should not library bookstock undergo similar treatment?

At this stage, the second (empirical) example must be provided. It is based on studies from samples of

(96a). The lack of date-stamps does not necessarily 'prove' usage-obsolescence, for the book may have been 'browsed' frequently, but, given the correlation coefficients of chapter one, this is very unlikely.

date labels at two central and three branch libraries between 1974 and 1978. They were undertaken to obtain primary data in respect of:

(i) the inter-book distribution of book-usage; and

(ii) the intra-book distribution of usage over time.

In some respects the information was atypical because:

(i) with the exception of the fifth study (Enfield Central), samples were taken from non-fiction shelves of subject categories 0 - 600;

(ii) on-shelf books are a non-circulating and presumably 'least popular' sample aggregate; and

(iii) both (i) inter-book average and (ii) intra-book time usage are slightly distorted because of the 'steady-state' nature of information, for 'future' issues of new books could not be reported, and therefore mean usage can be deemed <u>higher</u> and the time-usage curve <u>less</u> skewed.

The samples and sample sizes were in Ponders End Branch Library (200); Waltham Forest Central Library (100); Hadleigh Branch Library (50); Hayle Branch Library, Cornwall (50) and Enfield Chase Central Library (100)

The sample results are provided in Table 55. There is no contradiction with Table 51 which appears to show that average aggregate use of a book should be over 30 issues, even though for all samples except the Enfield Chase (biographical section) study (22.2) the mean usage of a book is only 11 or 12, for non-fiction books left on shelves would be much less popular than ~~than~~ circulating books, and the recorded information is 'steady-state' but, in some cases, 'half-life' information, i.e. 'future' issues of new books would not have occurred.

Further reconciliation of Table 55 with Table 51 was achieved by (a) the Enfield Chase study and (b) sample counts of (i) fiction books; (ii) returned books unshelved on trolleys; (iii) a sample count at Ware College and (iv) a fiction book count at Old Cross Library, Hertford, where some photocharged books contain date stamps because they have been added to stock from ticket-charged systems (e.g. mobiles). These supplementary studies served to confirm that although mean usage was low in four cases the pattern of distribution of usage was otherwise typical of books generally.

All studies showed that the inter-book distribution of usage was either Poisson or negative binomial. In the Ponders End study for example only 40% of books had been date-stamped less than 8 times, 38% were stamped between 8 and 20 times, 20% between 21 and 40 times and 2% between 40 and 50 times. As these were least popular books one can presume that if studies had been made of books in circulation (given secondary data on book usage in Table 51), particularly of fiction or biographical books, each of these frequencies could have been multiplied by a factor of 3. The frequencies were incidentally adjusted for the fact that the average opportunity for issue would have been 50% of the year of acquisition for the average acquisition would have been, in theory, on June 30 of the year of acquisition, and the frequency counts were limited to the first seven years after acquisition. The surveys indicated that in public libraries (in contrast with academic libraries) nearly 50% of usage takes place within the first two years after acquisition.

Thus, not only is the inter-book distribution of usage either Poisson or negative binomial, but the intra-book distribution of usage over time is, in fact, highly skewed. This may, indeed, be a function of repeated acquisitions and relegation of old stock on a date-label basis, and therefore a more ready phenomenon of public libraries than of academic libraries. There is evidence, for example, that when students are required to borrow an old 'set-book' from a public library there is a temporary increase in diachronous usage, because of revived popularity.

There is some evidence that, in the 'Buckinghamshire' trap (i.e. where annual bookfund is restricted to 12p per head of population and readers are thus driven to borrow older books) the diachronous pattern of book-borrowing becomes more linear. But these are exceptional cases. The evidence of the five frequency counts would appear to be that, although we must continue to regard bookstock as a composite single capital asset, there is necessarily a much greater revenue apportionment of funds because of the high rate of usage obsolescence. But this is only because a public library bookstock is not a static capital asset. If hypothetical example one (or the Buckinghamshire case) were applicable the average life of bookstocks could be much longer because people would be driven to read older books and they would therefore remain on shelves for longer periods.

The empirical studies represent a mid-position between two extremes:

(i) an implicit public desire to read most recent material; and

(ii) the fact that, if most recent material is not acquired, then older material will be read.

The first extreme position came to light in a linear regression model constructed from variables for the 32 London boroughs for 1969/70 and 1970/71. Although issues were best correlated with expenditure on bookstocks it was discovered that issues could be fitted with current acquisitions, aggregate stocks and a social class factor, using the linear equation:

$$Y = 696 + 18X_1 + 2X_2 + 66X_3 + U$$

where Y is the number of books borrowed per 1,000 of population;

X_1 represents quantities of books purchased the previous year per 1,000 of population;

X_2 represents aggregate bookstocks per 1,000 of population; and

X_3 is a social class factor, using percentages of owner-occupied housing per 1,000 of population; and

U is a random variable.

The model is not intended to be 'explanatory' for both stocks and acquisitions could be as much a function of issues as issues are a function of stocks and acquisitions. It needs considerable refinement, as I shall show in 8.3 and 8.4. Its importance is that the regression coefficient for current purchases ($18X_1$) is 9 times as large as the regression coefficient for aggregate stocks ($2X_2$). There is a hint that in this particular case current stock acquisitions contributed 9 times in quantity to issues as much as aggregate stocks.

This is an extreme, and I found no evidence of replication in other regression models. But it represents the extent to which a public would read current as opposed to dated literature if given the opportunity. Theoretical evidence for this assertion comes from Escarpit, who states in the Sociology of Literature that 90% of books are forgotten after one year and 99% after 20 years. Thus, if the five sample studies of Table 55 had been conducted using the circulating (rather than the stagnant (= shelved)) stock of public libraries given unlimited funds to acquire new books there may have been evidence that as many as 90% of date-stampings would have been identical with the year of acquisition (or, preferably, within twelve months of acquisition). In fact, only about one third of dates were stamped for the year of acquisition. This is mid-way between the 90% current usage dictated by public desire (as opposed to academic reading considerations) and the more slowly depreciating usage curve discovered in average usage frequency counts for academic libraries by Urquhart and Urquhart and by Buckland. To illustrate these I turn to the third set of case examples comprising this section of 8.2.

J.A. and N.C. Urquhart published their monograph in 1976 (97). It was not primarily concerned with patterns of inter-book and intra-book usage frequency distributions but they were incidental to that study and relevant to the current thesis. The monograph concerned the formulation of a decision rule for relegation in academic libraries. The Pebul Report (98) had stated that the 'weeding of bookstocks' of academic libraries was an 'ungrasped nettle' , and date-stamped label bases of relegation following Trueswell's rule (99) were criticised as inappropriate because although 90% of books were rarely used, they often contained essential information for academic studies (a condition less applicable to public libraries). Indeed Taylor (100) showed that even if relegated bookstocks were reintroduced into circulation from stacks as many as 28.3% of titles would be consulted (in one case, i.e. the exact sciences) within a 70-day period. Thus, in academic libraries, there is a greater case against relegation on a date-label basis because less books are regularly consulted and such relegation would involve mutilation of a bookstock by amputation of the very long tail of the inter-book usage frequency distribution curve.

Further, the intra-book frequency distribution curve is less skewed with respect to time because of a greater propensity to consult older books in academic libraries. But, skewed usage frequency distribution patterns are nevertheless discernible. As an academic library, Newcastle University Library illustrates that, even where older material is important for consultative purposes, usage is still negative exponentially distributed.

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97. J.A. and N.C. Urquhart: Relegation and Stock Control in Libraries (Oriel Press, 1976).
98. Durham University Library: Project for Evaluating the benefits from University Libraries (1969).
99. Trueswell, R.W. User Circulation Satisfaction vs. Size of Holdings at Three Academic Libraries (Coll. Res. Libr. 30 (3) May 1969, 204-213).
100. Op. cit. (97) p. 26.
101. Op cit. (97) p. 31.
102. Op cit. (97) p. 37.

Using 1973 as a base it was shown that 18% of all (101) 1972 acquisitions were borrowed, 11% of 1971 acquisitions, 9% of 1970 and 1969 acquisitions respectively, 8% of all books acquired between 1964 and 1968, 4% of books acquired between 1959 and 1963 and 1.93% of all books acquired before 1959. The numerical data can be reconverted to show that over 20% of issues were current year acquisitions and that just under 10% were previous year acquisitions, the frequencies falling for subsequent years from 7% to 0.

Thus, this academic study confirms, to a large extent, the results of the public library surveys for:
(i) cumulative frequency graphs drawn in the monograph indicate the <u>inter-book</u> usage distribution of <u>academic</u> libraries is also of a negative binomial shape, and for example 50% of books were not circulated within the previous 30 months, 32% were not circulated within the previous 90 months and 20% were not circulated within the previous 180 months (i.e. 15 years); and
(ii) the pattern of <u>intra-book</u> usage over time is either skewed or negative exponential but its period of usage is longer, and thus less skewed than in public libraries (101).

The authors discuss value in the context of (ii) above and state:
'From our definition we can see that '72 books are twice as desirable as '69 and '70 books and 9.5. times as <u>valuable</u> as pre-1950 books'; and
'The main <u>value</u> in terms of current use of a working academic library lies in its recently acquired stock. It should be assumed that new books would automatically be eventual candidates for relegation unless otherwise proved' (102).

This assumption of usage-based value and non-usage based obsolescence follows a tradition of older writers. For example, Buckland (103) attributed to books a negative exponential rate of obsolescence,

$y = ae^{-bt}$; (where y is usage, a is a constant, e the exponent, b a regression coefficient and t the time factor) and he quoted other writers, such as Line (104) and Brookes (105).

There are occasional anomalies where the usage of books tends to increase diachronously, but these (106) are most observable where there is a high absolute increase in total usage and absolute diachronous usage increases though relative usage decreases. But both Jain (107) and Theodora Andrews (108) while specifically engaging in category studies of book use also recognised that intra-book distribution of usage is a function of time.

We are now able to conclude this section on the discussion of capital and revenue aspects of book purchase. In theory a bookstock must be regarded as a complex heterogeneous capital asset. If the bookstock were stagnant with little acquisition and relegation it would conform very nearly to such a model, but public rather than academic libraries tend to relegate unused (or infrequently used) stock quickly to make room for new stock. An unbridled public taste would probably dictate that nearly 90% of usage would be in the year of acquisition and have very rapid obsolescence. Academic stocks tend to be obsolete at a slower rate, not because of stringent budgets but because of greater storage capacity. In practice the public library bookstock is poised somewhere between the rapidly obsoleting asset that public taste may determine, and more slowly obsoleting asset indicated in the works of academic librarians.

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103. Buckland, M.K. Book Availability and the Library User (Pergamon 1974).

104. Line, M.B. The 'half-life' of periodical literature: apparent and real obsolescence (Journal of Documentation 26, March 1970, 46-54).

105. Brookes, B.C. The Growth, Utility and Obsolescence of Scientific Periodical Literature 26, December 1970, pages 283-294)

106. For example, a textbook with slow increasing popularity.

The sample studies at the five libraries indicated in Table 55 come somewhere between these two extremes. The concept that books are 50% obsolete within two years is useful for determining the precise allocation between capital and revenue for public as opposed to university libraries. We can, for example, state that, if such studies are to be used in capital/revenue allocation, it would be justifiable to regard all acquisition as capital and employ a 'depreciation' write-down of 30% per year using an exponential usage-based depreciation rate. The effect may be similar to that currently employed, particularly if revenue expenditure amounted to 30% of written down value, but at least the treatment would be a theoretically justifiable one, which could be modified in years of particular stringency to show positive decline in capital values, and to show positive increase of capital values in years of particularly high bookfund expenditure. Further, this theoretical treatment shows the justifiability of considering bookfund expenditure as having capital implications for this thesis.

Thus since (i) books are heterogeneous, the 'revenue' treatment of bookfund expenditure (by analogy with commercial production) cannot be argued on purely theoretical considerations, and since particularly (ii) in public (as opposed to academic) libraries there is a high degree of obsolescence, the best theoretical view, that of a bookstock as a complex single capital asset, needs modification to (iii) the view of a capital asset with very high obsolescence (for example, 50% in 2 years).

107. Jain, A.K. A Statistical Study of Book Use: (Ph. D. Thesis) Purdue University 1968.

108. Andrews, Th. The Role of Departmental Libraries in Operations Research Studies in a University Library, Part 2 A Statistical Study of Book Use (Special Libraries October 1968) Conclusion 3 (p. 643) Age-adjusted use.

From this position we may argue a completely different treatment of expenditure on bookstocks from that commonly adopted, viz that all bookstock expenditures should be charged to capital and a relatively high rate of reducing balance depreciation be adopted to account for normal 'usage-obsolescence', this being about 28% per annum, i.e. 28% of cost in the first year and 23% of cost in the second year, thus writing off about 50% of value in the first two years on the pattern suggested in Table 55.

We need now to consider the implications of this adjusted view of bookstocks for the hypothesis that has been proposed, viz that capital inputs into libraries may be assessed by reference to the social income (estimated from book issues) that flows from such inputs. We have already seen in chapter two, that there is a much higher correlation between expenditure on books and issues than there is between other expenditures, normally designated as revenue, and issues. It does not necessarily follow that this greater correlation is, in any way, associated with the fact that the expenditure on books should be treated as capital rather than revenue, yet the distinction that we have made, that bookstocks should primarily be considered to be capital expenditure, does serve to sharpen the distinction between bookstock expenditures and other revenue expenditures. They can now be considered as a special case, for two reasons:

(i) the treatment of expenditure on bookstocks as revenue expenditure has its roots in local government practice rather than in sound theoretical considerations; and

(ii) there is, as we have already observed in chapter two, a more clearly observable correlation between expenditure on books and book-issues than between all other revenue expenditures and book-issues.

This high correlation coefficient (particularly for the 32 London boroughs) cannot be used as the basis of a theory that expenditure on books 'causes' issues because both issues and expenditures on books are highly correlated from one year to another, i.e. not only is each of them autocorrelated but there is high inter-variable correlation for any pair of two years. This was evident from the data itself quite apart from the results of both Durbin-Watson and Box-Jenkins tests. In the next section I propose to summarise some of the results apparent from the primary data of 32 London boroughs from 1966/67 to 1972/73. This was detailed in the earlier thesis submitted for the M.Phil degree. It has to be summarised at this stage because it forms a basis for a fuller treatment of capital inputs into bookstocks. We have to avoid two circular-reasoning fallacies:

(i) that, because there may be an even higher correlation between issue-adjusted revenue debits of bookstock values and issues using the method that I proposed, issues are necessarily a function of 'revenue' expenditure; and

(ii) that because expenditures per capita on bookstocks are correlated with issues of books per capita, bookstock expenditure has necessarily a 'causative' effect on issues.

The first fallacy can be ignored without much discussion. The model that I have proposed for correcting actual bookstock expenditure debits to 'real' usage debits to revenue is essentially a usage-based model. It is clear that correlation between revenue debits (using such a model) and issues would be artificially high because of the very nature of calculation of revenue bookstock (depreciation) debits. It does not affect the nature of enquiry into the extent to which capital expenditure on bookstocks (per capita) causes increments in issues (per capita).

The second fallacy requires detailed consideration and in 8.3. I summarise the results of my earlier investigation (6).

8.3. A Summary of Earlier Research into Effects of Expenditure on Bookstocks using the 32 London Boroughs for examination

Table 56 provides some data in respect of the correlation between (i) quantities of bookstocks purchased per head of population and (ii) expenditure on bookstocks per head of population for

32 London boroughs with (iii) the issues of books per head of population. It is apparent from the Table that there is a great degree of possible autocorrelation in the time series. I shall illustrate this later by using an inter-period correlation matrix for some of the variables concerned. At this stage, leaving aside autocorrelative considerations that will be examined fully later, it is apparent that:

(i) the values of the coefficients for both (i) expenditure on books and (ii) quantities of bookstocks purchased increase (in respect of issues) with recency, that is, there is, for example, a higher correlation coefficient between the issues of books (per capita) 1970/71 and the expenditure on books (per capita) 1970/71 than there is between the issues of books (per capita) 1970/71 and the expenditure on books (per capita) 1969/70. (It may, prima facie, be concluded that recent purchases of books and recent expenditure on books appear to have a greater effect on the issues of books than earlier purchases of books or expenditures on books for a given year, i.e. that the issues of year t are more affected by expenditure on books in year t, than that in year t-1, t-2 etc.); and (ii) there is greater correlation between (i) expenditure on books and issues (for all years of the series) than there is between (ii) quantities of books purchased and issues.

The first observation does not, per se, demolish an argument that expenditure on books could result from, rather than affect, issues: i.e. that boroughs are motivated to spend more on books where there is a high demand for them. Such an argument cannot be sustained from the data. If one, for example, proceeds to calculate the correlation coefficient between the issues of books in 1970/71 and the quantities of books purchased in 1971/72 the correlation coefficient is only 0.681 whereas that between issues and quantities purchased for the same year (1970/71) is 0.693. The difference between the correlation coefficients is not significant, but at least,- it suggests that issues are affected by quantities of books purchased rather than quantities of books purchased are affected by issues.

Further, the correlation coefficients do not increase with time as uniformly as the Table (56) suggests. There is a 'freak' correlation between Expenditures on Books for 1966/67 and issues for 1970/71 that is higher than that for 1967/68 (0.647) but this is exceptional and may result from the particular patterns of expenditure on bookstocks resulting from the reorganization of the London boroughs in the previous year.

The second observation appears to indicate that issues result from expenditures on books rather than from quantities of books purchased. Hence a library will not increase usage simply by playing a 'numbers game' and simply ensuring that it is adequately stocked numerically. There is, at least, some evidence that issues are more determined by cost than by quantity, that readers tend to borrow those expensive books that they prefer not to buy, rather than lower cost books. This is a generalization that requires some refinement. In libraries where there are less expensive books available, some borrowing occurs which is dictated simply by what is available. This is consistent with the regression constant in the equation 8.2. and with the model propounded earlier in the thesis, that the distribution of issues is combination of the Poisson distribution and a constant. (108a)

This refinement of the hypothesis that issues result more from expenditure than from quantities purchased can best be illustrated by dividing the 32 London borough set of data into two subsets, those whose issues were above the mean of all issues and those whose issues were below the mean. I should, at this stage, state for explanation, that the '33rd' borough, the City of London was not included in any investigation because of the peculiar 'per capita'

(108a). The constant in the model of chapter three represents a kind of 'floor' or minimum probable rate of issues per head of population, below which borrowing would not fall, irrespective of book-buying policy, a case amply illustrated in the recent policies of Buckinghamshire County Council.

values that resulted from the division of absolute values by the very small numbers of resident populations in the City for each of the years concerned. Despite the fact that the distribution of issues (even for London) was positively skewed, the median and mean for 1969/70 and 1970/71 did not differ significantly and consequently it was possible to divide the 32 observation data into two equal subsets of 16 observations each. The issue statistics of the Municipal Yearbooks had to be adjusted because (i) Camden contained record issues; (ii) Brent's treatment of institutional issues differed from that of others and (iii) there were some differences with primary data obtained from the boroughs themselves. When these adjustments were made, the following position was apparent for 1970/71:
(i) in the 16 borough subset whose issues per head of population were higher than the mean for all 32 London boroughs the correlation coefficient between (a) expenditure on books and issues of books (per capita) was 0.819 whereas (b) that between quantities purchased and issues of books (per capita) was only 0.738; while
(ii) in the 16 borough subset whose issues per head of population were lower than the mean (11.3) for all 32 boroughs the correlation coefficient between (a) expenditure on books and issues of books (per capita) was 0.528, while (b) that between quantities of books purchased and issues of books (per capita) was 0.629.

This difference seems to suggest that though issues may be a function of book-quantities, the values of issues per head of population result from a composite of factors that include expenditure on books, and that when expenditures are lower, issues will be lower, irrespective of quantities of books actually purchased in the relevant period.

Further studies showed that it did not follow that the upper-16 subset consisted solely of boroughs with high expenditures on bookstocks. In fact, in this subset, whose mean issues per head of population were 12.97, though the mean 1970/71 expenditure on books per 1,000 of population was £337.42, the standard deviation was £95, while in the lower-16 subset whose mean issues per head of population were

9.9 though the mean expenditure on books was only £296 per 1,000 of population the standard deviation was much lower (£51), and thus though the upper-16 subset consisted of boroughs whose expenditures on books were generally greater than the lower-16 subset, there was considerably greater variation in the upper-16 subset than in the lower-16 subset. Yet, it can be said with confidence that the lower-16 purchased greater quantities of books with available money than the upper-16 subset, for the mean of quantities of books purchased per effective £1,000 in the lower-16 subset was 910, but that purchased per effective £1,000 in the upper-16 subset was only 841.

One could relate this difference to the social class of the majority of residents of boroughs that comprise the two subsets, and in the earlier thesis I argued from Groombridge, that expenditure on books was more highly correlated to issues because of partial correlation of wealth (to spend on bookfunds) and social class, and of partial correlation of high issues with social class, and continued to illustrate the effect of social class factors on issues by using other indicators. For example, there is some association between social class and sparseness of population (or negatively between social class and density of population). If the boroughs are divided into two subsets (the 16 most densely populated and the 16 least densely populated) it can be shown that for 1969/70 data, for example, in the low-density subset of size 16, the correlation coefficient between expenditure on bookstock per head of population and issues per head of population was 0.806, while that between quantities of bookstock purchased per capita and issues per capita was only 0.495, but in the high-density (low social class) subset the difference between the coefficients was less (0.837 between expenditure on bookstocks per capita and issues per capita, but 0.792 between quantities of books purchased per capita and issues of books per capita).

Thus, there could be two explanations of the correlation coefficient differences. The greater correlation between issues and quantities purchased in respect of low-issue (high density) boroughs may indicate that the reversal of the expenditure/issue rule results from association with lower social class constituents of population, but may conversely indicate that issues <u>are</u> (up to a point) a function of quantity of books purchased, but that beyond this point higher values of issues per capita can be achieved by purchasing and having available more expensive books.

Other modifications of the principle were discussed in detail in the earlier thesis. For example, it was shown that when junior populations were computed (using such publications as (i) Local Health Services Statistics and (ii) Welfare Services Statistics, and aggregate junior issues were divided by such population sizes to obtain junior per-capita issue values there was greater correlation (for 1969/70 data) between child issues and junior aggregate bookstock than between junior issues and junior book-purchases, the difference being that between the correlation coefficients 0.795 and 0.688.

But these are modifications, and are not relevant to discussion at this stage. It is important to appreciate that generally:

(i). incremental issues (i.e. those above a given level per head of population) are more associated with the <u>values</u> of bookstocks purchased than with quantities of books purchased; and

(ii) though there is an autocorrelated series for both bookstocks and expenditures per capita and issues per capita, yet there is usually higher correlation between book purchases and book expenditures of year t and issues of year t than between those of years t-1, t-2 etc. and issues of year t.

There is thus little 'lagged' correlation in the model at this stage of the analysis.

Because of the results of density factors and the probable association of high density with low social class and otherwise low density with high social class, I used the expenditure/quantity dichotomy in the earlier thesis to pursue the effect of social class factors for the London boroughs on the rate of issues of books per head of population, showing that for typical years, for example,

$$Y = a + 21X_1 + 66X_2 + U$$

where Y represents issues per 1,000 of population, X_1 represents expenditure on books per 1,000 of population, X_2 represents social class measured by percentages of owner-occupied housing in each of the 32 boroughs concerned and U is a random variable.

This effect of 'social class' on issues was supported by other studies outside the London boroughs showing the lower rates of issues per head of population, the higher ratios of fiction to non-fiction borrowing and the lower values of books borrowed in areas of lower social class in other areas outside London.

I then returned to a consideration of whether, with or without adjustment for inflation, it could be said that indexed increases in the expenditures on books per capita from one period to another had the effect of producing indexed increases in the rate of borrowing of books per capita. Initially I considered probable inflation, taking (109) book-price indices from the Library Association Record and comparing them with my specific indices of book price changes for London. My own studies from London data using Public Library Statistics (S.C.T./C.I.P.F.A.) for the relevant years (110) showed some difference between London purchase indices and actual 'general' inflation indices. The differences are not evidences of inconsistency between the two studies. A Department of Education study that was not available to me when the earlier thesis was being written (111) showed that the book provision for London was atypical of that for the whole country (112) and that the BNB price index required considerable modification even for public libraries, that they did not agree with percentage increases in average books (or average book-prices) purchased for public libraries, and, because of the atypical nature of London data, would not certainly have agreed with that for London (113).

Table 57 provides my adjustment of BNB data, and Table 58 shows that this differs considerably from the rate of inflation in the mean cost per book for London boroughs (excepting the City).

Using these qualifications of book price analysis for London boroughs I continued by discussing the extent of autocorrelation in increases of expenditure on books per head of population in London. Table 59 shows the expenditure on books per head of population for the London boroughs from 1966/67 to 1970/71 and then expresses these as indices based on 1966/67 expenditures. Table 60 shows that book purchases per head (or per 1,000) of population are, in fact, highly autocorrelated. Table 61 provides the inter-year increases (i.e. chain indices) of increase in expenditure on books using aggregate values, and Table 62 shows the inter-year (i.e. chain indices) increases of quantities of books purchased taking aggregate values as the bases for calculation. It was shown that quantities purchased only increased between 1967/68 and 1968/69 and

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109. Index of Book Prices (Library Association Record: August, 1973 pp. 159 et seq). This data is a refinement of the BNB data published in 111 below.

110. Society of County Treasurers and Chartered Institute of Public Finance and Accountancy: Public Library Statistics (Publications from 1966/67 to 1970/71).

111. Department of Education and Science: The Purchase of Books by Public Libraries (HMSO: 1972).

112. op cit (111 above) Table 3, page 8.

113. op cit (111 above) Figure 2, page 7.

1968/69 and 1969/70, for using the data from table 62 the mean quantity 'increases' from one year to another were respectively 0.973, 1.008, 1.002, 0.999 and 0.985, those inter-year indices below 1.00 representing actual quantity decreases, while there were actual inter-year increases of cost for all contiguous (114) pairs of years, 1.088, 1.068, 1.071, 1.086 and 1.114. The coefficient of variation for expenditures for most years (0.32) was higher than that for quantities of books purchased (declining from 0.31 to 0.27), and this may indicate accommodativeness on the part of library purchasing departments to make funds as efficient as possible by stabilising the quantities of books made available, despite the more variable nature of fund allocations.

Further, though there is a good positive correlation between the inter-year purchase increases (or decreases) and the inter-year expenditure increases (or decreases) when these variables are those of identical pairs of years, (e.g. the correlation coefficient between

$$\frac{\text{Expenditures on Books 1970/71}}{\text{Expenditures on Books 1969/70}} \text{ and } \frac{\text{Quantities Purchased 1970/71}}{\text{Quantities Purchased 1969/70}}$$

is 0.6), there is generally poor correlation between increases and decreases of these variables (ranging between 0.32 and 0.41) when unmatched pairs of years are used.

The indices:

$$\frac{\text{Issues of Books for Year } t}{\text{Issues of Books for Year } t - 1}$$

are generally best correlated to:

$$\frac{\text{Expenditures on Books for Year } t}{\text{Expenditures on Books for Year } t - 1}$$

although there is some variability in correlation coefficients. Thus, that of 1970/71 in terms of 1969/70 for both variables is good (0.502) but that between expenditure and issue changes for other contiguous pairs of years is less than 0.4.

Finally, to eliminate lag effects from the model it was decided to calculate three-year changes in issues, expenditures on books and quantities of books purchased. The results are shown in Table 63, and indicate that although there is simple linear correlation between book expenditures and issues (Table 56) there is no necessary linear correlation of increases (or decreases) in expenditures over a three year period and increases (or decreases) in issues, either lagged or unlagged. In the particular case of Table 63, the correlation coefficient between the variables in columns 2 and 4 is 0.651 (i.e.in increases of book expenditures and book quantities between 1966/67 and 1969/70), and that between the variables in columns 3 and 5 is 0.584 (i.e. in increases of book expenditures and book quantities between 1967/68 and 1970/71), but the correlation coefficients between all of the variables representing changes in expenditures and quantities (columns 2,3,4 and 5) and the indicator of changes in issues (column 1) are all low and insignificant at the 5% level of significance, though they are positive. It is thus apparent that the effect of an increase in the (a) expenditure or (b) quantity of books purchased on (c) the issues of books is a non-linear one, if there is any measurable effect at all.

An effect can be postulated by examining all the observations in detail. From both Tables 57 and 58, ie. using either BNB and LAR adjusted data or my own calculated indices of inflation for the London boroughs, there is a mean increase between 1966/67 and 1969/70 or between 1967/68 and 1970/71

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114. This is a weighted series using aggregates. The simple unweighted means for Tables 61 and 62 are respectively 1.09, 1.07, 1.07, 1.09 and 1.11 for book costs, and 0.99, 1.01, 1.00, 1.01 and 0.99 for book quantities.

of about 30% (for three years). Let us use expenditures on books as the more reliable index of incremental capital inputs, but adjust by ignoring cases where mean expenditure increments are less than 30%. Barking is a particular case of capital input increments producing issue increments. The abnormally high 'increase' indices of expenditure on bookstocks for this borough result from having to restock a library that was destroyed by arson within the period. Thus though the inputs are shown conveniently as revenue expenditure they are essentially capital. Note from Table 63 that Barking has the highest increase of issues (1.2) between 1967/68 and 1970/71. Of the others, it is true of 67% of cases that where the mean increments of book expenditures for columns 2 and 3 are greater than 30% there is an increase in issues, that is, that adjusting for inflation, where there is a real increase in expenditure on books (making the 30% adjustment between monetary and real expenditure on books), there is correspondingly a real increase in issues of books, but that where after the 30% adjustment there is a decrease in real expenditure on books there is correspondingly a decrease in the issues of books.

There are exceptional cases, and these require attention. Enfield, Havering, Hillingdon, Hounslow, Kensington, Kingston and Sutton increased their issues between the two years despite poor real increases in expenditures after 30% adjustment, and the earlier thesis showed that these increases resulted from characteristics of the populations of these boroughs. Conversely, extra real expenditure in Islington, Bexley and Southwark did not achieve issue increments. Again, in the earlier thesis these exceptions were attributable to characteristics of the indigenous populations of the boroughs, of the kind discussed by Groombridge and others. We may, in summary, state that, although it is generally true that an increase in real expenditure on bookstocks (over a three-year period lagged to eliminate stochastic factors) produces an increase in the issues of books, and vice versa, there are exceptions attributable to social class factors.

8.4. A Summary of Later Research into the Effects of Bookstock Expenditures on Issues per Capita

We have shown in Section 8.3. that there is a three-year effect of bookstock expenditure changes (per capita) on issue changes (per capita), using a 30% inflation factor to adjust to 'real' values, but that this effect has no statistical significance without reference to the indigenous reading characteristics of the populations of the boroughs. Before investigating the effect of changes in bookstock expenditure on changes in issues per capita for English counties, we must question whether London is a special case, where there is greater correlation between bookstock expenditures and issues than for the English counties because:

(i). the effect of London commuting, inter-availability of tickets and the variability of reading habits of London borough populations, noted by Groombridge in his study, distorts the issues per capita values for the London boroughs, producing greater autocorrelation (i.e. time-series inter-year correlation) of issues than would be evident outside London; and

(ii) the bookstocks of London are more heterogeneous than those of the 39 English counties selected for study, because of special collections in London, and because emphases on acquiring particular relative amounts of (a) inexpensive books, (b) fiction books (c) children's books etc. tend to persist for each borough, producing greater autocorrelation of expenditures on books per capita than would be evident outside London.

With reference to (i) it is true that each county has its own 'pockets' of low interest and high interest in libraries, but, with few exceptions, inter-county differences would not be as great as London borough differences (compare Barnet or Camden with Newham) in the late 'sixties. Thus, although the issues per capita of London are highly autocorrelated, there is no necessary case for assuming the issues per capita of the set of 39 English counties to be similarly autocorrelated.

In this section I recount studies of London data subsequent to completing the M.Phil thesis (6) in 1975, assessing the extent to which the issues and bookstock expenditures of London are a special autocorrelated case. Details of these investigations have undergone considerable abridgement because of space constraints. In 8.4(i) I shall compare the autocorrelation of London issues with that of the 39 English counties used in this thesis, and in 8.4(ii) I shall compare the inter-period correlation of bookstock expenditures per capita with that of English counties. Section 8.4(iii) will discuss whether the autocorrelation of London bookstock expenditures is associated with the self -perpetuating differences of London bookstock compositions, judging:

(a) the statistical characteristics of absolute quantities of low-priced, medium priced and expensive books acquired by each borough;

(b) the ratios between low-priced and medium-priced, and medium-priced and expensive quantities acquired, and their inter-period correlation;

(c) the inter-period correlation of the ratio of fiction to non-fiction books; and

(d) the effect of junior bookstock purchases.

I shall show that relative quantities of low-priced books are highly autocorrelated and may be associated with the high autocorrelation of expenditures on London bookstocks.

In 8.4(iv) I re-examine the effects of one-year and three -year changes in expenditures on bookstocks on changes (i.e. increases or decreases) in the rate of issues per capita, and 8.4(v) examines the features that make London a special case other than those stated in (i) and (ii), by judging the effect of heterogeneous acquisition (e.g. special collections and the other persistent characteristics of 8.4(iii)), and also by assessing the effect of capital expenditure on bookstock acquisition. This effect will be illustrated by showing that London fixed service points are non-increasing in frequency (so that, with the exception of Barking noted in 8.3 there is little necessary association between bookstock acquisition and other capital expenditure categories), but that the English counties' fixed service points were increasing in frequency during the period studied, and that the increases of fixed service points and of bookstocks for the English counties are associated and may be regarded as twin aspects of the same capital decisions.

8.4(i). The inter-period correlation of issues of books

The London issues per capita are much more highly correlated than those of the 39 English counties, and they are more stable, using either the period of the earlier research (1966 to 1973) or that of the later research (1969 to 1976). For example, using the period from 1967/68 to 1970/71 the annual absolute means range from 2,818,134 to 2,871,763. This stability of means and aggregates exists despite the 20% per capita change for Barking discussed earlier. The coefficients of variation remained at about 0.25 for each period, and autocorrelation is very high, for absolute issue frequencies produce correlation coefficients that are never below 0.96 for pairs of adjacent years (e.g. 1969/70 and 1970/71) and pairs separated by one year (e.g. 1969/70 and 1971/72), and never lower than 0.94 for pairs separated by two years (e.g. 1967/68 and 1970/71). These absolute values of issues are so highly correlated that, for example, in the 1970/71 case the year's issues (I_t) can be accurately estimated using the regression model:

$$I_t = 47{,}000 + 0.99 I_{t-1} + U$$

where I_{t-1} are the absolute values of issues for 1969/70 and U the residual component. There is some reduction when these coefficients are adjusted for population differences. The correlation coefficients of issues per head of population for the period range between 0.75 and 0.79. These values correspond to those of partial time-series coefficients between issues for two years controlling for population. As the lowest 'uncontrolled' time series coefficient for issues (over six years) is 0.9 and the lowest coefficient between (115) issues and population for any year is 0.7, the partial correlation

115. D. Pitt Francis: Cost-Benefit Analysis and Public Library Budgets (Library Review Vol 25, 5/6 (1975)) p. 192 shows it to be 0.731, for example, using 1973/4 data.

coefficient can be estimated, controlling for population:

$$\frac{0.9 - (0.7)^2}{\sqrt{(1 - 0.7^2)(1 - 0.7^2)}} = \frac{0.41}{0.51} = 0.8 \text{ (approximately).}$$

This partial correlation coefficient does not differ significantly from typical coefficients of issues per capita though calculated from absolute values controlling for population, and checks those values of between 0.75 and 0.79.

The autocorrelation of issues per capita used for computing indices I,J,K and L for the 39 English counties is very much lower. Those between adjacent pairs of years are 0.553 (between 1969/70 and 1970/71) and 0.570 (between 1974/5 and 1975/76), while the correlation between issues per capita for pairs of years separated by a five- or six -year period are much lower (e.g. between 1969/70 and 1975/76). They range from 0.307 and 0.402.

We can thus judge that there is much greater autocorrelation of issues per capita for the London boroughs than for the 39 counties used in the current study, because London is a special case, affected by commuter distortion, special collections, inter-availability and indigenous reading patterns. Thus, because of less 'inbuilt' time series correlation of issues per capita, the 39 English counties comprise a fairer test of the hypothesis of association between bookstock expenditures and issues, in which the special conditions of London do not apply.

8.4(ii). The time-series correlation of bookstock expenditures

In 8.3. I discussed the interperiod time-series correlation of bookstock expenditures for the London boroughs using data of the years 1966/67 to 1970/71, and illustrated the matrix in Table 60. The pattern is a self-repeating one and the coefficient of variation of per capita bookstock expenditures is stable at 0.25. For these years the lowest coefficient is 0.77, but for the period (e.g. 1969/70 to 1975/76) used for the current (county) study it is lower (0.47) but significantly positive because:

(i) estimates based on historical costs are used for future budgets, so that 'generous' and 'stringent' expenditures for particular boroughs are self-replicating; and

(ii) the special conditions of London enhance autocorrelation.

Thus, as I explained in the earlier thesis (116), we can dismiss regression models expressing issues (for a single year) in terms of expenditures on bookstocks (for a single year) as useful predictive models because of the extent of the autocorrelation of both variables. If we use absolute values of expenditures and issues the value of R^2 is very high (between 0.78 and 0.91) when the use of an added variable (percentage of owner-occupied housing) as an estimate of social class and reading habits is also included.

Taking absolute values, (to give just one example), the equation for 1967/68 data is

$$I_t = 560{,}000 + 28.6E_t + 12650S_t + U$$

where I, E and S are respectively absolute values of issues and expenditures on bookstocks and the percentages of owner-occupied housing. The partial values of F are respectively 48.171 and 9.558 for E and S and both are significant using a 32 borough sample. We can, to some extent, eradicate the effect of differences of population sizes, by using a logarithmic regression equation (as population sizes are more logarithmically than linearly distributed) :

$$\text{Log } I_t = 2.955 + 0.689 \text{ Log } E_t + 0.130 \text{ Log } S_t + U$$

but the extent of variation explained (dismissing the effect of the autocorrelation of both variables) would still be high (62% in this case).

I state this, an example of the effect of autocorrelation on the two variables for London, already explicit in the earlier thesis (116) but which further research indicated to be the case for all years examined. (116a).

The question is now whether there is such a great difference

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116. M. Phil Thesis (6. supra) chapters 11 to 14.

116a. Autocorrelation, i.e. the correlation of a variable with itself, is specifically used in this chapter to mean the correlation of corresponding pairs of observations of a variable for two different years, e.g. t and t +3. Measures of autocorrelation, e.g. the Durbin-Watson statistic, measure the autocorrelation of an ordered series, e.g., t, t+1, t+2....

between the time series correlation of expenditures on books (per capita) of London and that of English counties as was the case with issues (per capita). For example, would Table 60's value 0.77 for a coefficient between London's expenditures on books separated by 3-4 years also be typical of English counties?

In fact, for English counties, the coefficients are never as high as 0.77 for correlation of this variable between any two years t and t+3. Before 1970, the correlation coefficients were high (e.g. 0.55 between years t and t + 3, and 0.61 between years t and t + 2) because, although the counties did not have special conditions of London (e.g. special collections, boroughs reflecting wide variations of reader's tastes, etc.) estimating of future expenditures was largely historically determined, so that policies (whether expenditure should be generous or stringent for a particular county) tended to be self-replicating. But in the particular years that we are considering the position radically changed and counties' expenditures on bookstocks were even less self-replicating. For example, the Pearson correlation coefficient between expenditures on bookstocks for 1970/71 and 1973/74 is only 0.23, and is lower for autocorrelated pairs (t, t+3) for subsequent years. The rank correlation coefficients are also affected. For example, Buckinghamshire ranked highest in expenditures on books in 1970/71 with 33.7p per capita but lowest in 1975/76. In this county correlation, the performance of this one county reduces the rank correlation coefficient (t, t + 5) by 0.06.

A complete discussion of the lower autocorrelation of English counties (both in respect of issues and books) is not possible because of the space constraint, but we may conclude that London is, for both variables, a special case. Its issues per capita are highly autocorrelated because of different borrowing patterns for each borough, and its expenditures on books are highly autocorrelated because of (i) historical cost-based estimating (a condition only partly applicable to counties) and (ii) specific book-buying emphases of each London borough, which I propose to measure in 8.4(iii).

8.4(iii) Inter-year consistency of expenditure patterns

In 8.4(ii) I stated that the inter-year correlation of expenditures on books for London was a special case because of the specific expenditure patterns of each London borough. This can be briefly demonstrated by examining expenditures on the categories of books purchased (low-priced, medium-priced and expensive and fiction, non-fiction). Before doing so, we should state that despite these special conditions (for London) the typical pooled values of 'single year' correlation coefficients (using Fisher's t) between quantities of books purchased and expenditures (0.875) are invariably higher than quantities purchased and aggregate bookstocks (0.632) or even between expenditures (0.796) purchased and aggregate bookstocks (all variables per head of population). So, the effect of special collections and book-buying policy on single years' values of the variables should not be overestimated for London.

Yet there are persistent differences in relative spending by boroughs on low-priced, medium-priced and expensive books. For example, using 1970/71 data, the coefficient of variation of aggregate quantities of books priced under 62½p. is 0.53, though that for the other two categories is lower (those between 63p and £2.10 and those over £2.10), at 0.33 and 0.37 respectively. Further, the correlation coefficients between absolute values (frequencies) in the three categories are not perfect (yet they range from 0.66 to 0.73). Incidentally, it can be consistently shown that absolute values of issues are invariably more highly correlated with quantities of expensive books purchased than with the other two categories. Even if we confine the analysis to large boroughs with dense populations (in contrast with smaller boroughs (e.g. Kingston and Richmond) with higher social class content, that between aggregate (absolute) issues and aggregates of expensive books purchased is 0.528 but that between absolute values of issues and of low-priced books is only 0.343.

Persistent inter-year spending patterns are best examined with ratios. From 1967/68 to 1970/71 the mean ratio of medium-priced to low-priced books was 4.48 and the standard deviation 2.5, the coefficient of variation 0.55 indicating wide differences of spending between boroughs. These were persistent, for the time-series correlation of this ratio produced coefficients between 0.74 and 0.86.

On the other hand, the time series correlation of the ratio of high-priced (over £2.10) and medium priced books produced lower coefficients (normally between 0.33 to 0.38), with one exception (that between the ratio values of 1969/70 and corresponding values for 1970/71 exceeded 0.5). There was also less variability, for the grand mean of ratios was 0.81 and the standard deviation 0.15, a coefficient of variation of 0.19.

Thus, some inter-period correlation of expenditures on bookstocks may at least be associated with, though not necessarily attributable to, the proportions of lower-priced books acquired by each of the London boroughs, for they were highly variable (inter-borough) but highly correlated (inter-period) over time.

Another aspect of the autocorrelation of expenditures on books that required study was the ratio of fiction to non-fiction books. The inter-period correlation of values of this ratio decreased between 1966/70 and 1970/71 from 0.906 to 0.668. The grand mean ratio for these years was 1.12 but there was considerable variation of standard deviation (for each year) between 0.256 and 0.398. Although there was considerable negative correlation between issues per capita and the fiction/non-fiction ratio for some years (e.g. -0.468 for 1969/70 and -0.357 for 1968/69) this was not a persistent phenomenon. It need not follow that an increase of issues may result from a reduction of the fiction stock component. It simply means that in London those boroughs that acquire more fiction are generally identical with those whose borrowing per capita is low.

Other aspects of library bookstocks were studied with respect to the effect of their composition on the autocorrelation of expenditures on bookstocks and on the autocorrelation of issues per capita. An interesting ratio is that between quantities of children's books acquired and aggregate quantities of books purchased. It is highly variable, using the values of the ratio between 1967/68 and 1971/72 for the 32 London boroughs, but does not correlate either with issues or with any of the other ratios that have been used in this subsection to study the differences in the compositions of bookstock. Boroughs contain large differences in the proportion of child populations, and these differences, inter alia, dictate the amounts of children's books acquired relative to aggregate purchases. The full study of this ratio cannot be described because of the space constraint. For example, Camden and Newham have widely different values of issues per capita but similar child/aggregate acquisition ratios. The absence of correlation may result from two compensatory factors. Low social class populations tend to have larger families and lower borrowing per capita, yet children (rather than adults)are taught to use libraries. In some cases, child/aggregate acquisition ratios reflected child borrowing patterns in immediately previous years.

Studies of data 'outside London' also indicated that this was the case. For example, in Swindon, prior to the effect of the 1972 Act the issue data showed a decrease between 1971/72 and 1972/3, but issues to schools increased (1.04 for fiction, 1.38 for non-fiction and 1.07 for project material). Subsequent book-buying was sensitive to this increase. Similar results were apparent in London, where, for example, the junior issues of Croydon for the same period were highly variable, and where book-acquisition reflected junior issues. Thus the inter-year autocorrelation of expenditures on books and of issues per capita is not affected by the different value-compositions of children's books acquired or of junior issues (relative to aggregate issues) but intra-borough studies showed that, in some cases, buying was sensitive to prior use by children (in immediately previous years).

Thus we conclude 8.4(iii) by summarising that the inter-year correlations of expenditures on books per capita of London are a special case compared with the English counties in the current study (8.4(ii)) because of persistent inter-year differences in the spending patterns of boroughs, that there is particularly an inter-year consistency in boroughs' expenditure on low-priced books, seen in the high coefficient of variation for this category and in the high autocorrelation between the values of low/medium priced book acquisition ratios for any pair of years. The autocorrelation of expenditures on books per capita may be associated with, though not entirely attributable to, the autocorrelation of this ratio for any pair of years. There is less autocorrelation of the ratios between expensive and medium priced books, but there is high correlation between absolute frequencies of expensive books acquired and absolute values of issues. There is less evidence that autocorrelation of expenditures on books per capita resulted from other category differences (e.g. the ratio of fiction to non-fiction books or the ratio of children's books acquired to aggregate acquisitions) but there is an interesting, negative, correlation between the fiction/non-fiction ratio and the issues of books per head of population, though this is not persistent for all years. We can therefore argue that the autocorrelation of expenditures on books for London may be attributable to category differences, as well as to special collections and the self-replicating nature of historical-cost estimating. It is sufficient to examine some of the reasons why (because of the co-operation between and special features of the London boroughs) there is greater need for concern with the autocorrelation of London issues and bookstock expenditures per capita than with those of the counties in our specific domain of study in this thesis.

8.4(iv). Subsequent studies of the effect of changes in expenditures on books on changes in issues per capita

In 8.3. we concluded an account of the earlier research associated with the data of the 32 London boroughs by giving the results of tests to discover whether yearly and three-yearly changes in expenditures on books per capita produced yearly and three-yearly changes in issues per capita.

Considerable work on the London data continued after the presentation of the earlier thesis (6). Correlation coefficients were calculated between (i) changes in bookstock expenditure per capita and (ii) changes in quantities of books purchased per capita for each of the years from 1966/67 to 1971/72, having re-examined (e.g. in 8.3(iii)) some of the reasons for the disparities between expenditures on bookstocks and quantities purchased. For each pair of years:

$$\frac{\text{Expenditures on books } (t)}{\text{Expenditures on books } (t-1)} \quad \text{were correlated with}$$

$$\frac{\text{Quantities of books purchased } (t)}{\text{Quantities of books purchased } (t-1)}$$

The correlation coefficients were dissimilar for each pair of years. From the comparison between 1967/68 and 1966/67 onwards the correlation coefficients are in chronological order:

0.676, 0.388, 0.360, 0.613 and 0.311

The high correlation coefficient for $\frac{\text{Data } 1967/68}{\text{Data } 1966/67}$ may be the result of a random process or may be associated with the buying by London boroughs after their reorganization in the previous year. It can be seen that despite the disparities of 8.3(iii) there is still good, though not necessarily significant, correlation between increases in costs of books and increases in quantities purchased (or decreases in some cases). Logarithmic correlation produced for this series of years the series of coefficients in order:

0.718, 0.355, 0.356, 0.641 and 0.386.

It can be seen that there is no significant difference between the two sets of correlation coefficients. They are positive but not necessarily significant. An increase of real expenditure on bookstocks does not necessarily equally represent a quantitative increase in bookstocks for all boroughs. The diversities of 8.4(iii) are applicable. In this context, it should again be stressed that all studies showed greater correlation between increases of expenditure on books and changes (increases or decreases) of issues per capita than between increases of quantities and changes of issues per capita. Positive correlation coefficients can always be found, but they are not always significant. The t/t-1 increases in the variables, bookstock expenditure per capita and issues per capita for 1970/71 in terms of 1969/70 are correlated at 0.502, and the pair of variables for 1968/69 in terms of 1967/68 are correlated at 0.203, and the pair, bookstock expenditure changes per capita and issues per capita changes for 1967/68 in terms of 1966/67 are correlated at 0.248. But the extent of correlation is lower for some years. Some of the poor correlation was later discovered to be attributable to the fact that some boroughs (6 in all) had used estimates of some issue subcategories (e.g. institution lending) where values were not available. Recalculating the correlation coefficients for the remaining boroughs (26) produced the linear correlation coefficients between increases in expenditure on books per capita and changes in issues per capita:
0.659, 0.344, 0.315, 0.661 and 0.322;
for the years from 1966 to 1972;
and the logarithmic correlation coefficients:
0.763, 0.421, 0.414, 0.625 and 0.285.

It can be seen that the coefficients are not invariably higher than those of the full set of 32 London boroughs (excluding the City).

For this set of data, the correlation coefficient between increases of issues per capita and increases of bookstock expenditures per capita in 1970/71 over 1969/70 was higher(0.616) but the earlier correlation coefficients between one year increases (or decreases) in both variables were not significantly different. Also changes in issues per capita (t/t-1), 1969/70 in terms of 1968/69, were lag-correlated with increased bookstock expenditures per capita (1968/69 and 1967/68 respectively in terms of 1967/68 and 1966/67), i.e. t-1/t-2 and t-2/t-3, but the coefficients were not significant (0.28 and 0.29).

Because of this lag-correlation I re-examined the three-year increase variables of Table 63 using only the 26 boroughs described above. The correlation matrix is shown in Table 64. The results are a little more encouraging, for increases in expenditures on books and quantities of books purchased are now significantly correlated for both overlapping three-year periods (0.651 and 0.584 respectively). Further, the expenditures on bookstocks (in terms of increases) are positively correlated with increases of issues of 1967/68 to 1970/71. (0.289 and 0.335 respectively), but the F-value is not significant at the 5% level though higher than that (1.889) obtained for all 32 boroughs. The best linear approximation associating these inter-year increases is:

$$I_{t/t-3} = 0.869 + 0.106E_{t/t-3} + U.$$

where I and E respectively represent changes in the variables, issues per capita and expenditures on bookstocks over three years.

One would not expect significant correlation, for the reasons given in 8.3., but again, if those boroughs that are known to have in-built high borrowing rates (associated with the factors listed by Groombridge, discussed earlier) are excluded, the linear coefficient between I and E is 0.513. This is not significant where n = 21, so it is preferable to revert to the hypothesis of 8.3. and assume that increases in borrowing do reflect increases in real expenditure on bookstocks, but that the effect is non-linear and inapplicable to those boroughs whose issues per capita ~~as~~ are so high that a 'saturation' level has been reached, or to those whose issues per capita are high because of indigenous social characteristics.

8.4(v). Other limiting factors

Before we proceed to an analogous study of counties in 8.5. we must examine one other reason why the cases of the 32 London boroughs and the English counties are different. It is that, in London, bookstock acquisition did not reflect parallel development of new libraries during the period of the earlier thesis (6) while in the case of some English counties bookstocks and new libraries developed alongside each other.

Table 65 provides the complete data of London fixed service points and mobiles in the period of the earlier thesis. It is self-explanatory. Most service point frequencies were stable, but some (e.g. Camden) actually decreased.

Thus, with the exception of Barking, where both bookstock and building were destroyed and needed parallel replacement, there was no need for bookstocks to replenish new libraries at that time. Central libraries were partly replenished from original stocks (St. Pancras) and branch libraries were partly replenished from within the authority's area. A classical example may also be provided outside London. When the 'shop-premises' library in the Epsom and Ewell area was replaced by a purpose-built library, the decrease of adult bookstocks at Epsom from 35,120 in 1968/69 to 32,860 in 1971/72 partly offset the increase of adult bookstocks at Ewell Village from 24,860 to 29,440 over the same period. This is typical of the way in which (Tables 65a/b) new libraries are actually replenished except where the frequency of service points in the authority area is actually increased. In such cases a new set of basic bookstock has to be acquired. I have already shown in earlier chapters that in the case of the English counties from 1969/70 to 1975/76 the actual numbers of service points actually increased for some counties (e.g. Cornwall). In such cases one would expect there to be parallel increases in bookstock acquisition other than those that can be regarded as normal 'revenue' acquisitions.

Thus, when we examine county library bookstock expenditures in 8.5. it is necessary to categorise two distinct sets of counties (i) those where the increases in bookstock expenditures per capita are associated with increases in frequencies of fixed service points, and may be twin-aspects of the same capital decisions, and (ii) those where a great deal of capital has been expended on building (e.g. a central library), such as Gloucestershire and Rutland, but where it is assumed that the bookstocks are partly carried over from earlier libraries.

We can now summarise the results of this additional research of London boroughs pursued subsequent to the earlier thesis (6). We have seen that London is a special case because:
(i) issues per capita are more highly correlated to each other over time, reflecting pockets of high and low interest in borrowing, associated with social climate and other factors and studied earlier by Groombridge;
(ii) bookstock expenditures are also more highly autocorrelated than for the English counties, because of different types of acquisition, and to some extent, special collections;
(iii) studies of particular ratios reflecting different categories of bookstock acquisition did not, ipso facto, prove that they accounted for the autocorrelation of London bookstock expenditures (especially fiction/non-fiction, child/aggregate etc.), but there was evidence that the low-priced/medium quantity acquisition ratio was highly variable and autocorrelated, indicating that some boroughs persisted in acquiring more cheap books (relatively) than others; and
(iv) London's bookstock acquisition patterns are not significantly associated with service-point development, and not with new building, except in obvious cases such as Barking.

Further studies of London data under 8.4(iv) indicated that the hypothesis of a non-linear association (effect) between real increases in expenditure on bookstocks and changes (increases) in issues per capita could be upheld, particularly for boroughs where issue data was reliable and where borrowing-interest was not very high for other reasons.

8.5. The effect of expenditures on Bookstocks on issues in English counties between 1969 and 1976

Having studied the special conditions of London in 8.3. and 8.4. we can now examine the effect of the expenditure on bookstocks per capita on issues per capita in the sample of English counties selected earlier, over the period studied in the previous chapters. The conditions of 8.3. and 8.4. show that there is less need, in the case of the English counties, to be concerned with autocorrelative adjustment between the two variables. We may suspect that between the two variables the correlation coefficients for the counties for any single year are lower, because there is greater variation (less autocorrelation) of both variables over time. We have shown already, for example, that Buckinghamshire had the highest per capita expenditure on bookstocks in 1970/71 but the lowest per capita expenditure four years later. Thus, we may suspect that, because there is a part-lagged effect, issues for any year do not correlate very highly with the bookstock expenditures for that year.

A good example of this observation is that of the correlation coefficient between bookstock expenditures and issues per capita for 1975/76 where, for the set of 39 counties, the coefficient is only 0.21, the F-value is insignificant (1.11) and less than 2% of the variation could be explained by analysis of variance, even assuming that neither of variables were autocorrelated, but we have already shown in 8.4. that there is some autocorrelation, though it is considerably less than for London. To some extent, this coefficient was affected by high values of single observations and by other extreme cases. For example, the Gloucestershire issues per capita for that year (18.2) were atypical and (116b) though the bookstock expenditure per 1,000 of population was high (£402) the issues were higher than could be attributable to bookstock expenditures alone. At the other end of the scale, Salop and Staffordshire had low values of issues per capita despite moderate spending (£340 and £401 per 1,000 of population).

(116b). Although inclusive of issues to schools, it is still significantly high.

This year is illustrative, and to some extent, it is exceptional. Buckinghamshire's issues per capita are moderate partly because of good previously acquired bookstock despite poor current spending.

We have already shown earlier in this chapter that, under normal circumstances, i.e. other than the Buckinghamshire case, current acquisitions are subject to most borrowing (over 50%) within the two years after acquisition. If we are to judge the effect of increases in the expenditures on bookstocks (either in real or in monetary terms) on increases (or other changes) in issues per capita measured by indices I,J, K and L, it is necessary to obtain the drift of expenditures on books during the middle years of the period, because there is some autocorrelation (as I showed in 8.4.) in the earlier years 1968/69 to 1970/71, and because the years 1974/75 and 1975/76 are part-affected by the implementation of the 1972 Act.

To measure the expenditures per capita increases in the form:

$$\frac{\text{Expenditures per capita on bookstocks 1973/74}}{\text{Expenditures per capita on bookstocks 1970/71}}$$

provides the best three year index for the counties of the form used in 8.3 and 8.4 for London. The increases are monetary, the mean of the index is 1.587 and the standard deviation 0.34. Thus the coefficient of variation is similar to that of London for the earlier years, although the conversion to real expenditure changes using the inflation indices of the B.N.B. and L.A.R. provided earlier, indicates that there was a decrease in inflation-adjusted, real spending, with the acquisition of more paperbacks and cheap books. For this total set the correlation coefficient with index L is poor, 0.12, as is the percentage of variation explained by analysis of variance (0.6) and the F-value 0.3.

However, our study of fixed service points in 8.4(v) indicates that the very differences between the counties and London in terms of fixed service point frequency changes may dictate a categorisation of our 39 county sample.

If we compare Tables 44 and 65 we can deduce that in the cases of some counties, the fixed service point 'syndrome' was similar to London, for bookstock acquisitions were not always associated with fixed service point development, though there may have been increases of issues per capita associated with capital development (e.g. building a central library) with no associated necessary increase in bookstocks. These are cases such as Gloucestershire and Durham and we may add cases such as Bedfordshire where the building of a central library may have affected issues (for reasons explained earlier) without a necessary contemporary increase in bookstocks because of expansion of the number of new libraries.

In all, the exclusion of such cases leaves the mean increase of expenditure on bookstocks per capita between 1970/71 and 1973/74 (in monetary terms) at 1.52,(i.e. by 52%). For a particular set of counties where there is a known increase in the frequency of service points and therefore an associated necessary increase in bookstock expenditures per capita the association between increases in bookstock expenditures and index L (explained earlier) is a much more definite one. Cumbria witnessed considerable building of libraries in new locations, Northampton several new libraries in the period 1969/70 to 1973/74, as did Northumberland, Cornwall, Leicester, Norfolk, Berkshire, Wiltshire, Somerset, Derby, Hampshire, Cheshire, Kent and Lancashire. It is this group and similar counties, where there was either (i) a known increase of the frequencies of full-time points between 1969/70 and 1973/74 or (ii) an expansion of bookstocks for other capital reasons, association with increases of part-time service points and mobile libraries, that provides the best correlation coefficient between the increase in bookstock expenditures per capita (1970/71 to 1973/74) and issues per capita measured by index L (measuring increases between 1970/71 and 1975/76).

In the case of this particular category, though the mean increase in expenditure on books per capita is lower, at 47% (1.47), the actual correlation coefficient between the increase of bookstock expenditure and index L is 0.755, the sequential F test produces a significant F-value (25.13) and the regression equation is

$$L = 0.904 + 0.115E_{\frac{t-2}{t-5}} + U$$

where L is index L earlier defined in this thesis and $E_{t-2/t-5}$ represents expenditure increases between 1970/71 and 1973/74. But this regression equation applies only to a subset of the data, that where there is complementary increase in the frequency of service points, and some excluded counties such as Gloucestershire must be explained by factors inappropriate to this equation where the increase denoted by this county's value of index L may be attributed to central capital development and the effect of school issues on the statistics, rather than to any increase in expenditures on bookstocks.

8.6. Summary and Conclusions

These are provided in Chapter 10, 10.2. Conclusions 71 to 78

Table 55. An Analysis of Some Date-Stamp Studies

Details	Library Samples				
	A	B	C	D	E
Issue Frequencies					
Year 1	915	453	221	223	815
2	541	288	139	154	510
3	467	203	102	116	402
4	222	121	52	62	199
5	184	69	21	31	141
6	118	36	13	17	99
7	104	16	9	12	58
Relative Frequencies					
Year 1	35.9	38.2	39.7	36.2	36.6
2	21.2	24.3	25.0	25.1	22.9
3	18.3	17.1	18.3	18.9	18.1
4	8.7	10.2	9.3	10.1	9.0
5	7.2	5.8	3.8	5.1	6.4
6	4.6	3.1	2.3	2.7	4.4
7	4.1	1.3	1.6	1.9	2.6
Aggregate	100.0	100.0	100.0	100.0	100.0
Aggregate Absolute Frequencies	2551	1186	557	615	2224
Sample Size	200	100	50	50	100
Mean per Book	12.75	11.86	11.14	12.3	22.2

Notes

1. The libraries were respectively those of Ponders End, Waltham Forest Central, Hadleigh (Essex), Hayle (Cornwall) and Enfield Chase Central.

2. The above values require readjustment because of the 'steady -state' nature of information, i.e. 'future issues' of new books are omitted. If typical values 38%, 25%, 17%, 11% 5%, 3% and 2% are adjusted using the weighting factors 7/7, 7/6, 7/5, 7/4, 7/3, 7/2 and 7/1 respectively and then readjusted to add to 100%, the resulting values are 29%, (approx). 23%, 15%, 10%, 8%, 6% and 4%. This is a near-exponential distribution, yet it is still true that about 50% of usage takes place in the first two years, i.e. high obsolescence.

3. The low means of date-stamps per book for A,B,C and D result from using on-shelf and therefore least-popular books, taking early non-fiction categories. In the case of E the biographical section was used. Small trolley samples of fiction indicated that if high turnover books had been studied mean usage would have been higher. Further, many of the books had been in stock for one or two years. See the note 2 above.

4. The means are, in any case, atypical for inter-book issue distribution is highly skewed, 40% were stamped less than 8 times, 38% between 8 and 20 times, 20% between 21 and 40 times and 2% over 40 times in the Ponders End case.

Table 56. Some correlation coefficients showing the relationship between issues per capita and (a) expenditure on books and (b) quantities of books purchased.

	Issues of Books per Capita		
	1968/69	1969/70	1970/71
Expenditures of Books per Capita during years:			
1967/68	0.663	0.675	0.611
1968/69	0.673	0.698	0.639
1969/70		0.738	0.682
1970/71			0.733
Quantities of Books purchased per capita during years:			
1967/68	0.559	0.600	0.505
1968/69	0.649	0.690	0.609
1969/70		0.698	0.630
1970/71			0.693

Notes.

1. The above correlation coefficients are based on data for the 32 London boroughs (except the City of London).

2. Because of inter-period autocorrelation of the three variables concerned it cannot be argued from the above coefficients (though significant) that either of the two variables necessarily affect the issues of books per capita, but:

3. Both variables are highest correlated to the issues of year t than are the variables of years t-2, t-1 etc, indicating that a 'lagged effect' is not likely; and

4. Expenditures per capita are more highly correlated to issues per capita than are quantities purchased per capita.

5. The text indicates that there are exceptions to 4. above.

6. Although the coefficients are not shown between the issues of period t, and the purchases and expenditure of periods t+1, t+2 etc. some trial results showed that the values of correlation coefficients began to decline after year t in each case. Thus, it is unlikely that quantities of books purchased and expenditure on books result from issues of books, i.e. the reverse of that hypothesised.

Table 57. Adjusted Figures of Inflation on Books showing 1966/67 and Chain Index Alterations.

Year	L.A.R./ B.N.B. Index	Index converted to 1966/67 base	Chain Indices of Annual Inflation Rates
1965/66	114.3	89.3	-
1966/67	128.1	100.0	12%
1967/68	149.8	117.0	17%
1968/69	159.3	124.4	6.3%
1969/70	193.2	150.9	21.2%
1970/71	212.2	165.8	9.4%
1971/72	222.0	173.4	4.6%

Note

The first column values are constructed from two sources

(i) The Index of Book Prices (Library Association Record, August, 1973, pp. 159 et seq); and

(ii). Department of Education and Science: The Purchase of Books by Public Libraries, Table 3 page 8. (HMSO 1972).

Table 58. Table of actual London mean inflation values constructed from the mean costs per book for London boroughs

Year	Population	Purchases of Books		Physical Purchases	Cost per Book (Mean)	Increase on previous year
		per 1,000 £	Actual £'000			
1966/67	7,909,000	249	1973	2180193	£0.90	-
1967/68	7,876,230	272	2146	2122274	£1.01	12.5%
1968/69	7,759,610	295	2294	2140314	£1.07	5.8%
1969/70	7,699,060	319	2456	2145047	£1.15	6.9%
1970/71	7,607,500	361	2748	2143482	£1.28	12.0%
1971/72	7,413,680	401	2971	2110785	£1.41	9.8%

Notes

(i). The explanation of differences between the two sets of chain indices lies in:
- (a) the differences in amounts of low cost books purchased for London; and
- (b) inter-period lags and the move to lower cost books late in the period.

(ii). From the two tables it is apparent that there is a 30% cost increase between 1967/68 and 1970/71.

Borough	1966/7	2/1	1967/8	3/1	1968/9	4/1	1969/70	5/1	1970/1.
Barking	147	1.25	184	1.36	200	1.66	245	2.12	311
Barnet	252	1.19	301	1.26	319	1.43	360	1.62	409
Bexley	198	1.14	225	1.31	259	1.34	265	1.57	311
Brent	228	1.04	237	1.15	263	1.32	302	1.39	316
Bromley	183	1.02	186	1.15	211	1.55	284	1.91	350
Camden	428	1.11	475	1.25	535	1.37	585	1.56	669
Croydon	160	0.94	151	1.11	177	1.24	199	1.55	249
Ealing	222	1.10	244	1.26	280	1.34	297	1.46	324
Enfield	287	1.12	323	0.97	280	0.94	270	1.05	302
Greenwich	254	1.02	260	1.07	271	1.15	293	1.30	330
Hackney	284	1.05	298	1.09	309	1.13	322	1.17	333
Hammersmith	222	1.13	251	1.31	292	1.45	323	1.62	360
Haringey	204	1.04	212	0.99	203	1.17	239	1.42	290
Harrow	189	1.26	238	1.27	241	1.43	271	1.61	305
Havering	340	0.69	236	0.74	252	0.78	267	0.85	289
Hillingdon	238	1.03	245	1.08	258	1.10	261	1.18	281
Hounslow	289	1.17	339	1.32	383	1.30	377	1.44	418
Islington	224	1.40	314	1.60	358	1.70	380	1.68	377
Kensington	233	1.08	251	1.09	255	1.19	277	1.42	332
Kingston	225	1.13	255	1.28	288	1.32	298	1.41	317
Lambeth	297	1.11	330	1.15	342	1.21	359	1.19	353
Lewisham	245	1.12	274	1.22	299	1.37	337	1.31	322
Merton	206	1.12	231	1.21	249	1.32	272	1.51	311
Newham	175	1.19	209	1.21	213	1.37	240	1.55	272
Redbridge	229	1.07	246	1.30	297	1.30	297	1.42	326
Richmond	235	1.09	257	1.35	318	1.39	326	1.62	381
Southwark	236	1.18	278	1.32	313	1.46	345	1.56	368
Sutton	270	1.11	300	1.31	355	1.27	342	1.39	375
Tower Ham.	244	1.12	273	1.20	292	1.35	330	1.53	373
Waltham F.	285	0.99	281	1.06	303	1.09	312	1.01	289
Wandsworth	265	1.13	299	1.17	309	1.22	324	1.35	358
Westminster	438	1.11	484	1.27	556	1.38	604	1.49	652

Table 59 Expenditure on Books (per 1,000) 32 Boroughs

Note. The intermediate columns (2/1, 3/1, 4/1 and 5/1 express the per capita expenditures of years 2,3,4 and 5 respectively as indices based on year 1. With some exceptions these are increases.

	1966/67	1967/68	1968/69	1969/70	1970/71
1966/67	1.000	.901	.864	.830	.770
1967/68	.901	1.000	.966	.936	.876
1968/69	.864	.966	1.000	.974	.921
1969/70	.830	.936	.974	1.000	.966
1970/71	.770	.876	.921	.966	1.000

Table 60 Correlation Matrix - Book Costs per 1,000

32 London Boroughs - Years 1966 to 1971

Borough	1966/67		1967/68		1968/69		1969/70		1970/71		1971/72
Barking	25188	1.24	31298	1.08	33980	1.21	41150	1.25	51673	1.11	57587
Barnet	79926	1.19	95051	1.06	101038	1.12	113277	1.13	128190	1.13	145974
Bexley	42734	1.14	48542	1.15	56000	1.02	57158	1.17	66936	1.16	77583
Brent	67222	1.04	69660	1.08	75026	1.13	85064	1.03	88033	1.05	92962
Bromley	55418	1.02	56506	1.14	64268	1.34	86299	1.22	105793	1.12	118096
Camden	102693	1.10	113107	1.10	123995	1.08	133586	1.12	149305	1.12	166565
Croydon	52350	0.95	49834	1.17	58500	1.11	65285	1.25	81732	1.00	81847
Ealing	67535	1.09	73902	1.13	83880	1.06	88553	1.08	95766	1.09	104773
Enfield	76965	1.12	86284	0.87	75032	0.96	71951	1.10	79411	1.09	86399
Green'ch	59020	1.02	60133	1.04	62420	1.07	67029	1.12	74821	1.11	82901
Hackney	71422	1.04	74330	1.01	75203	1.02	76997	1.01	77854	1.08	83699
Ham'sth	47553	1.12	53321	1.08	57795	1.08	62412	1.08	67710	1.16	78851
Har'gey	52114	1.04	53949	0.93	49936	1.16	58042	1.19	69267	1.12	77838
Harrow	39627	1.25	49634	1.01	50305	1.12	56390	1.11	63031	1.11	70011
Havering	85214	0.70	59336	1.07	62577	1.06	67564	1.08	72938	1.16	84473
Hil'don	55566	1.04	57538	1.06	61178	1.01	62047	1.07	66426	1.19	79227
Hounslow	59998	1.17	70315	1.12	78819	0.98	77307	1.10	85486	1.05	89593
Is'ton	57306	1.39	80090	1.08	86729	1.04	89841	0.95	85814	1.00	86014
Kens.	50316	1.07	53647	1.00	53849	1.07	57863	1.17	67803	1.21	82329
Kingston	32910	1.13	37159	1.12	41639	1.03	42842	1.06	45348	1.20	54307
Lambeth	101073	1.10	111582	1.01	112850	1.04	117008	0.97	113655	1.11	125684
Lew'm	71053	1.12	79540	1.06	84201	1.13	95300	0.95	90065	1.10	99167
Merton	38044	1.11	42339	1.09	45962	1.09	50068	1.13	56524	1.06	60055
Newham	45348	1.19	53953	1.01	54559	1.11	60539	1.11	67437	1.19	80340
Red'ge	56619	1.07	60576	1.20	73162	0.99	72840	1.09	79333	1.07	85375
Richm'd	42347	1.09	46013	1.22	56371	1.02	57633	1.15	66571	1.09	72943
South'k	71974	1.16	83675	1.10	91922	1.09	100436	1.05	104959	1.14	120050
Sutton	44909	1.10	49641	1.19	58884	0.97	57035	1.09	62566	1.00	62626
T.Ham.	49485	1.09	54146	1.04	56252	1.10	62113	1.09	68021	1.03	70200
Waltham	68359	0.98	66924	1.07	71828	1.02	73618	0.92	67999	1.26	85835
Wand'th	88066	1.12	99058	1.00	99459	1.04	103513	1.10	113810	1.28	145567
West'r.	115124	1.09	125322	1.08	135849	1.07	145381	1.05	152871	1.06	162464

Table 61 Calculation of expenditure upon books from Public Library Statistics, and rates of increases in expenditure upon books - 32 London boroughs

Note All expenditure values are in pounds (£'s).

Also note that rates of increase between years are in the intervening columns: thus, for Barking, for example, $\frac{\text{Expenditure 1967/68}}{\text{Expenditure 1966/67}} = \frac{31298}{25188} = 1.24$

Borough	1966/67		1967/68		1968/69		1969/70		1970/71		71/72
Barking	36141	1.38	50218	0.80	40462	1.11	44940	1.09	49029	0.89	43569
Barnet	81775	0.90	74283	1.19	88422	1.06	93895	1.11	103861	1.06	109827
Bexley	50258	1.09	55289	1.06	58815	0.93	55127	1.00	55270	1.03	57188
Brent	76875	0.97	74879	1.00	74989	1.00	75644	1.00	75618	0.90	67738
Bromley	89424	0.71	63638	1.06	67773	0.98	66654	1.23	81803	1.00	81738
Camden	90302	1.03	93500	1.11	104290	0.98	103109	0.92	95293	1.07	102278
Croydon	58446	0.78	45640	1.16	53093	1.13	60038	1.50	90022	0.62	55786
Ealing	73430	0.95	70079	1.13	79226	1.04	82466	0.93	76837	0.94	72088
Enfield	80030	0.99	79577	0.84	67617	0.80	54764	1.07	58882	0.93	54667
Greenwich	62438	0.97	60853	0.94	57269	1.02	58862	1.01	59493	1.02	60528
Hackney	86688	0.96	82958	0.94	78286	0.93	73532	0.93	68422	0.99	67593
Hammersmith	53324	1.04	55559	1.00	55677	1.04	58351	0.98	57647	1.07	61962
Haringey	49768	0.97	48652	0.89	43765	1.21	53012	1.02	54428	1.00	54375
Harrow	40418	1.34	54248	0.83	45317	1.03	46830	1.05	49188	0.98	48706
Havering	105512	0.58	61577	0.88	54412	0.97	53004	1.01	54027	1.00	54158
Hillingdon	55157	0.96	53054	1.00	53506	1.07	57656	0.86	49921	1.07	53257
Hounslow	64219	1.06	68319	1.04	71055	0.87	62280	1.10	68585	0.87	59356
Islington	72263	1.17	84849	0.99	84040	1.05	88758	0.83	74507	0.87	65187
Kensington	57029	0.95	54700	0.89	49212	0.94	46327	1.09	50924	1.07	54692
Kingston	34433	1.13	39163	1.00	39197	0.96	37938	0.95	35746	1.09	38847
Lambeth	112561	1.04	118147	0.96	114269	0.92	105771	0.90	94759	1.18	111370
Lewisham	74596	0.92	68945	1.09	75725	1.04	79099	0.84	67043	0.99	66607
Merton	43907	0.97	42600	0.99	43216	1.06	45884	1.01	46499	0.88	40822
Newham	53781	0.83	44504	1.21	54095	0.85	46125	1.01	46875	1.16	54507
Redbridge	62416	1.34	83824	0.83	70301	1.22	85833	0.70	60222	0.94	56898
Richmond	48623	0.97	47531	1.16	55239	0.97	53954	1.05	57049	0.95	54352
Southwark	67618	1.15	78248	1.06	83322	1.14	95506	1.16	110829	0.82	90919
Sutton	50141	1.00	50488	1.02	51999	0.89	46576	1.05	48960	1.46	71332
Tower H.	55946	1.12	62752	0.93	58475	1.01	59355	1.00	59515	0.92	55001
Waltham F.	77815	0.80	62378	1.16	72687	0.84	61529	0.99	60993	0.97	59403
Wandsworth	104019	0.89	92914	1.02	95370	0.96	92106	0.94	86752	1.12	96745
Westminster	110830	0.89	98908	0.99	98833	1.01	100122	0.94	94483	0.95	89919

Table 62 Calculation of quantities of books purchased by public libraries during 1966/72 and rates of increase in purchases - 32 London Boroughs

Note that rates of increase between years are in the intervening columns; thus, for Barking, for example, $\frac{\text{Quantities 1967/68}}{\text{Quantities 1966/67}} = \frac{50218}{36141} = 1.38$

Borough	Issues 1970/71 / 1967/68	Book Expenditure 1969/70 / 1966/67	Book Expenditure 1970/71 / 1967/68	Book purchases 1969/70 / 1966/67	Book purchases 1970/71 / 1967/68
Barking	1.200	1.634	1.650	1.243	0.976
Barnet	1.041	1.417	1.269	1.148	1.398
Bexley	0.956	1.337	1.379	1.097	0.999
Brent	0.937	1.265	1.263	0.984	1.010
Bromley	1.009	1.557	1.872	0.745	1.28[illegible]
Camden	1.000	1.300	1.320	1.142	1.019
Croydon	1.035	1.247	1.640	1.027	1.972
Ealing	1.042	1.311	1.296	1.123	1.096
Enfield	1.057	0.935	0.920	0.684	0.740
Greenwich	0.983	1.136	1.244	0.943	0.977
Hackney	0.977	1.078	1.047	0.848	0.825
Hammersmith	0.980	1.312	1.251	1.094	1.038
Haringey	0.739	1.114	1.284	1.065	1.119
Harrow	1.101	1.423	1.270	1.159	0.907
Havering	1.036	0.793	1.229	0.502	0.877
Hillingdon	1.103	1.117	1.154	1.045	0.941
Hounslow	1.060	1.288	1.216	0.970	1.004
Islington	0.930	1.567	1.071	1.228	0.878
Kensington	1.007	1.150	1.264	0.812	0.931
Kingston	1.085	1.290	1.220	1.102	0.913
Lambeth	0.932	1.158	1.019	0.940	0.802
Lewisham	0.954	1.341	1.132	1.060	0.972
Merton	1.085	1.316	1.335	1.045	1.092
Newham	1.005	1.335	1.250	0.858	1.053
Redbridge	1.076	1.286	1.310	1.375	0.718
Richmond	1.045	1.361	1.447	1.110	1.200
Southwark	0.932	1.395	1.254	1.412	1.416
Sutton	1.006	1.270	1.260	0.930	0.970
Tower Hamlets	0.869	1.255	1.256	1.061	0.948
Waltham Forest	0.992	1.077	1.016	0.791	0.978
Wandsworth	0.934	1.176	1.149	0.885	0.934
Westminster	0.966	1.263	1.220	0.903	0.955

Table 63 Tabulation of Overall Changes - 32 London Boroughs.

Note. These calculations of three-year 'overall' indices (to obviate random and episodic disturbances associated with one year changes) are explained in the text. They compare issues, expenditure and purchases for associated periods.

CORRELATION MATRIX

	X(1)	X(2)	X(3)	X(4)	Y
X(1)	1.000	.547	.651	.285	.198
X(2)	.547	1.000	.176	.584	.243
X(3)	.651	.176	1.000	.190	.062
X(4)	.285	.584	.190	1.000	-.035
Y	.198	.243	.062	-.035	1.000

Table 64. Correlation Matrix for the variables of Table 63

(see 8.4(iv) for explanation).

Borough	1966/67			1967/68			1968/69			1969/70			1970/71			1971/72		
	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M
Barking	8	3	–	8	4	–	8	4	–	8	4	–	8	4	–	8	4	–
Barnet	16	–	2	16	–	2	16	–	2	16	–	2	16	–	2	16	–	3
Bexley	13	1	2	13	1	2	13	1	2	12	2	2	12	2	2	12	2	2
Brent	12	–	1	12	–	1	12	–	1	12	–	1	12	–	1	12	–	1
Bromley	14	1	3	14	1	3	14	–	4	14	–	4	14	–	4	14	2	3
Camden	17	–	–	17	–	–	16	–	–	16	–	–	14	–	–	14	–	–
Croydon	16	1	–	16	1	(1)	14	1	–	14	1	–	14	1	–	14	1	–
Ealing	12	1	4	13	–	5	13	–	5	13	–	5	13	–	5	13	–	5
Enfield	15	–	1	15	–	1	15	–	1	15	–	1	15	–	1	15	–	1
Greenwich	13	–	2	13	–	2	13	–	2	13	–	2	14	–	2	14	2	2
Hackney	16	3	–	16	3	–	16	3	–	16	3	–	16	3	–	16	3	–
Hammersmith	8	–	1	8	–	1	8	–	1	8	–	1	8	–	1	8	–	1
Haringey	11	–	3	11	–	3	11	–	3	11	–	3	11	–	1	11	–	1
Harrow	10	–	1	9	–	1	9	–	1	9	–	1	9	–	1	9	–	1
Havering	10	–	–	10	–	–	10	–	(1)	10	–	–	10	–	–	10	–	–
Hillingdon	14	–	2	13	3	2	14	–	2	15	–	2	15	–	1	15	–	1
Hounslow	10	–	–	10	–	–	10	–	–	10	–	–	10	–	–	10	–	–
Islington	11	1	–	11	1	–	11	–	–	11	–	–	11	–	–	11	–	–
Kensington	6	–	–	6	–	–	6	–	–	5	1	–	5	1	–	5	1	–
Kingston	8	–	–	8	–	–	8	–	–	8	–	–	8	–	–	8	–	–
Lambeth	14	–	2	14	–	2	(15)	–	2	14	–	2	14	–	2	14	–	–
Lewisham	14	–	1	14	–	1	15	–	1	15	–	1	16	–	3	16	–	3
Merton	9	–	–	9	–	–	9	–	–	9	–	1	9	–	1	9	–	1
Newham	14	–	3	(30)	–	3	10	–	3	10	–	3	10	–	3	10	–	3
Redbridge	9	4	2	(11)	4	2	9	4	2	10	2	2	10	2	(–)	10	2	2
Richmond	11	1	–	11	1	–	11	1	–	11	1	–	11	1	–	11	1	–
Southwark	18	–	2	18	2	2	19	–	2	19	–	2	18	–	3	18	–	3
Sutton	8	2	–	8	2	–	8	2	–	8	2	–	7	1	1	8	1	1
Tower Hamlets	14	1	–	13	1	1	14	–	1	14	1	1	14	1	1	13	1	1
Waltham Forest	13	–	1	13	–	–	13	–	–	13	–	–	13	–	–	13	–	–
Wandsworth	14	–	2	14	–	1	14	–	1	13	–	3	13	–	1	13	1	2
Westminster	11	2	–	12	3	–	12	3	–	12	3	–	12	3	1	12	2	1

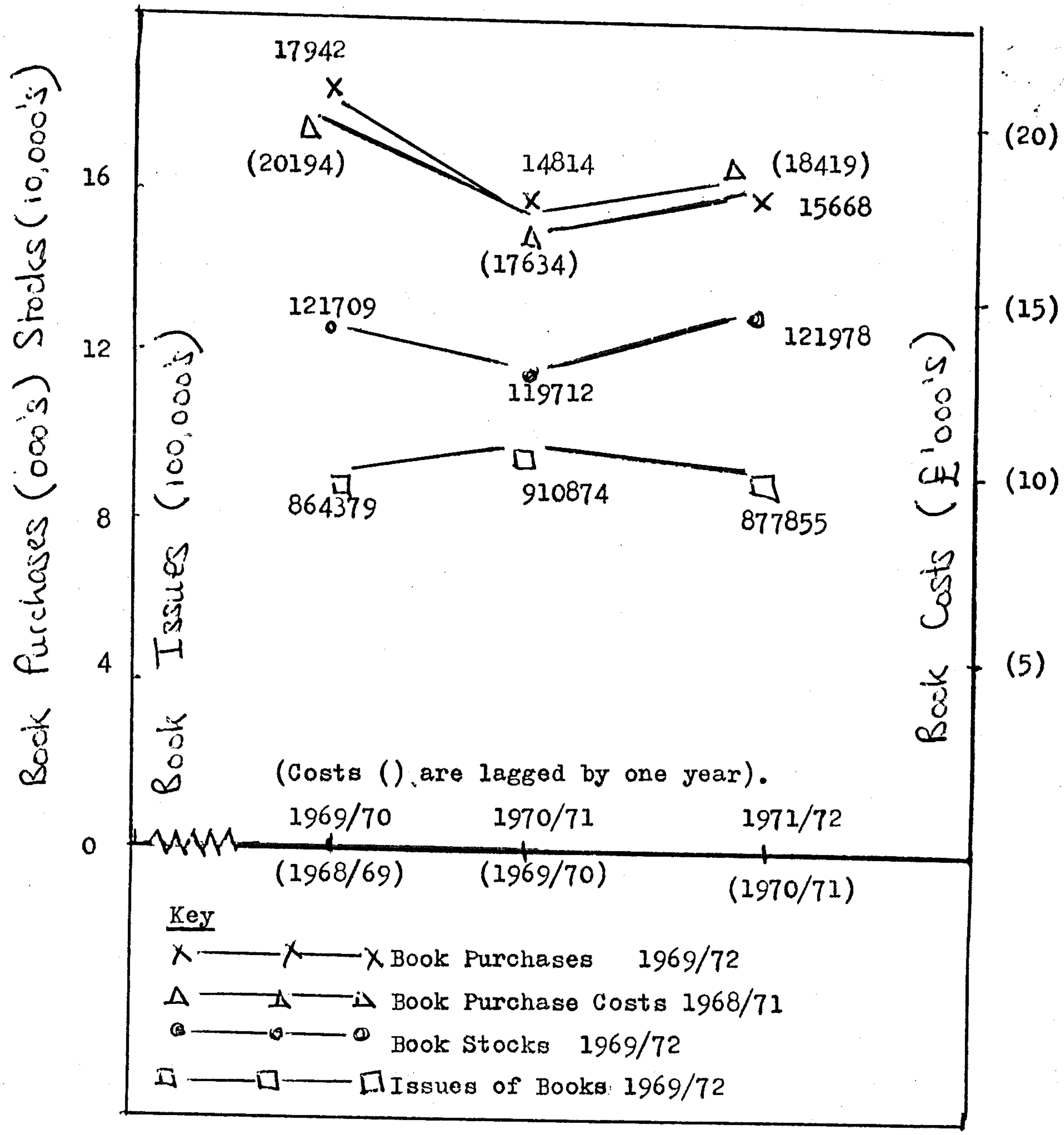
Table 65 Full-time, part-time and mobile service units, as given in Public Library Statistics - period 1966/1972 - 32 London Boroughs.

Key: F = full-time libraries, P = part-time libraries M = mobile librarie

Figures appearing in brackets () are those which although taken from Public Library Statistics appear to be incorrect when the total information is reviewed.

Table 65a. The Epsom - Ewell Effect

Falling purchases and increased issues



Notes

1. This table is presented to clarify the statement made in chapter 8 in respect of the effect of the opening of Ewell Village library in February 1970 on issues. (See 8.4(v)).

2. Although issues seem to move in the reverse direction to stocks, purchases and lagged costs, the large increase in issues in 1970/71 is wholly attributable to the opening of the new Ewell Village library whose adult section issues alone rose from 94,670 in 1968/69 to 119,000 in 1969/70 to 305,000 in 1970/71 taking some of the issues that would have been made by other libraries in the system.

Table 65b. Some Analysed Values in respect of Ewell Village Library to explain the trend in Table 65a.

Details		Loan Stock	Issues
1. Ewell Village Library		(000's)	(000's)
Adult	1968/69	25	95 (3.8)
	1969/70	21	119 (5.7)
	1970/71	26	305 (11.7)
	1971/72	29	327 (11.3)
Junior	1968/69	2	15 (7.5)
	1969/70	5	23 (4.6)
	1970/71	6	73 (12.2)
	1971/72	7	69 (9.9)
2. Stoneleigh			
Adult	1968/69	15	176 (11.7)
	1969/70	15	172 (11.5)
	1970/71	14	145 (10.3)
	1971/72	13	118 (9.1)
Junior	1968/69	5	47 (9.4)
	1969/70	4	44 (11.0)
	1970/71	4	35 (8.8)
	1971/72	4	29 (7.3)
3. Cuddington			
Adult	1968/69	6	52 (8.7)
	1969/70	7	53 (7.6)
	1970/71	6	47 (7.9)
	1971/72	6	43 (7.2)
Junior	1968/69	2	13 (6.5)
	1969/70	2	13 (6.5)
	1970/71	2	11 (5.5)
	1971/72	2	11 (5.5)
Issue/Stock Ratios are given in Brackets.			

Notes.

1. Both Tables 65a and 65b should be examined in conjunction with Table 65 to show the limiting effects of site-changes (i.e. increases and decreases of service-points) on bookstocks and issues in the short run.

2. Note that in this case, issues follow the popularity of a new library (Ewell Village) in February 1970, and bookstocks are later adjusted because of demand, with some small reduction of issues in other libraries in the system. Statistics of Epsom are not relevant, nor are those subsequent to the 1972 Act.

Chapter Nine: Human Capital and Library Benefits

9.1. Introduction

'Human capital' has received some attention in recent years. Though it is recognised that the level of human investment is difficult both to estimate and to measure, it is sometimes currently suggested by accountants that the 'human capital' factor can be capitalised by taking the sum of an annuity representing the difference between the salary and the gross benefit that the employee provides to the firm. As the benefits are estimates (using issues) and this research seeks to assess the effect of all 'capital' regressors on issues, the use of issues in calculating the regressor would not be admissable, but an approximation of human capital investment may be obtained by applying a capitalization factor to the employees' salaries themselves, and then assessing whether or not it correlated with the issues of books.

This would be a simplistic application of recommended accounting procedure, but there were reasons for not pursuing such a course in this thesis. In this chapter I shall examine relevant aspects of human capital. The chapter will take the following form:

(i) an explanation of the reasons why the accounting formula for the estimation of human capital investment is not relevant to this thesis;

(ii) an analysis of library human capital in terms of investment in training rather than investment in employees, and a discussion of the difficulty of measurement both in the academic library and public library contexts;

(iii) an assessment of two measures of investment in training, using the frequency of qualified library personnel per head of population and the relative frequency of trained library staff (i.e. in terms of aggregate staff); and

(iv) a discussion of conclusions.

9.2. The defects of human capitalization factors

There were strong reasons for not assessing the level of human capital investment simply by applying a capitalization factor to employees' salaries. In the earlier thesis (6) an attempt was made to correlate employees' salaries (per capita) with the issue statistic (per capita). The research was, of course, confined to the 32 London boroughs but the correlation coefficient between employees' salaries per capita and issues per capita was low when the values of the variable were taken from identical years and approached zero using paired variable values for non-identical years. In all cases the coefficients were certainly much lower than those between expenditures on books per capita and issues per capita for corresponding periods. The earlier thesis studied such correlation coefficients between 1966/67 and 1972/73. Even when using revised data, of the kind already described in 8.4(iv), it is observed that the correlation coefficients between employees' salaries and bookloans per capita were as low as 0.280, and the correlation coefficients between increments in both variables, using procedures analogous to that used for bookstocks in 8.3. and 8.4(v) were almost non-existent.

There are some exceptions for high-performance boroughs, such as those in London whose issues of books exceed 12 per capita. For one exceptional year (1970/71) the correlation coefficient between expenditures on employees per capita and issues per capita was 0.528, but for this group the sample size was small (n = 16) and the coefficient therefore insignificant.

There are firm reasons for the absence of correlation. Most library staff do not issue books, and their salary levels are determined nationally, as are staff establishments, at least in recommendation. Public Library Service Points (116) provides useful guidelines on the subject of staffing,

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116. Library Advisory Councils of England and Wales: Public Library Service Points (HMSO 1971)

and though there is variability, vis à vis service points absolute frequencies of staff in all categories are less variable than is apparent. Attempts to correlate expenditure on employees per capita with issues per capita led to disparate differences. In particular the boroughs of Barnet, Camden, Sutton and Westminster had high issues per capita in comparison with employee-expenditure-based regression estimates, while for Croydon, Haringey, Kensington, Tower Hamlets and Newham the reverse was apparent, for no reason other than the fact that these two sets of boroughs had the highest and lowest sets of issues per capita respectively. When the correlations between the variables are not controlled for population (i.e. when absolute values, not per capita values, of both variables, are correlated), the coefficients are between 0.5 and 0.6 for all years, but because of correlation with population size and with other variables. For 1971/72 and 1972/73, for example, there are interesting correlations of 0.825 and 0.792 respectively between absolute expenditures on bookstocks and staff establishments, for no other reason than that staff establishments must be relatively large if bookstocks are large. For 1971/72 there was also a good positive correlation coefficient between staff establishment and metres of shelving (for London($r = 0.391$)) though the position was reversed in the following year ($r = -0.158$). But these are obvious cases where the size of borough may affect the correlation coefficient. In 'per capita' or 'per unit of population' terms there is no obvious correlation between employees' salaries and issues, whether a capitalization factor is used or not, and since salaries are uniformly determined, there is no obvious correlation between staff establishment per capita and issues per capita.

The correlation between staff frequency and staff salaries should be obvious, but a little explanation may be required at this stage, particularly because it introduces the approach that will be adopted later in this chapter. Salary provision correlates with (i) staff establishment and (ii) the number of hours per week required for servicing libraries. Staff salaries can be expressed in terms of opening hours for most years between 1966 and 1974 with a high correlation (pooled at about 0.65), i.e. for 1971/72

$$S = £(38,000 + 255.730H + U); \text{ and}$$

for 1972/73:

$$S = £(52,000 + 285,142H + U)$$

where S represents aggregate salaries for the year, H the aggregate number of opening hours per week for all types of service points and U the residual component.

Since employee salaries statistics are correlated with aggregate, opening hour statistics, which are in turn a function of fixed service points, little purpose is served by correlating employees salary data with issues because of joint correlation with premises.(117)

Thus we must abandon the study of this simple correlation between employees' salaries and issues bedause:
(i) the correlation coefficients are low; and
(ii) the variables are jointly correlated with premises because of high dependence of staff establishment on opening hours and of aggregate opening hours on premises.

We can instead explore a more relevant aspect of human capital, the extent to which the investment in qualifications, in the training of library staff, can be effective in increasing the issue statistic.

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117. The normal per capita correlation coefficients for the years 1965 to 1971 with the issue statistic were (i) premises (0.331), books (0.584); bookstocks (0.484) and population density (-0.325) but only 0.285 between expenditure on employees per capita and issues per capita.

9.3. The measurement of administration and training potential

The simple application of accountant/economist formulae to library employees' salaries takes little account of the heterogeneous nature of library staffs and the degree of investment in training. In the case of public libraries, the extent of employment of qualified (as against unqualified) staff is partly measurable because the professional qualification component of the establishment is published, but this takes no account of other categories of academic ability so that the analysis is limited. Within the compass of this thesis it is impossible to reduce the great diversity of other degrees and qualifications to a common comparable yardstick.

Yet the matter is, though formidable, not as difficult as would be the case with the study of academic libraries. These are often administered by non-professional librarians, or by Senate committees (in some universities) of whom the secretary is of professorial rank, but not necessarily a professional librarian (118). But differences cannot be easily studied because of the inter-authority non-variability of relative qualified staff frequencies (119). Particularly in academic research libraries improvement and library development are known to be a function of leadership as well as training (120). In some cases, particularly Japan, (121) the librarian of a department is more a specialist in the discipline of the department than in library science and the matter affects public library administration because of Japanese joint usage of libraries.

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118. Stockham, K.A. The Government and Control of Libraries (Deutsch, 1974) page 16 ff.

119. The Roberts Report recommended that 40% of non-manual staff be qualified librarians, and there has been some movement towards standardization.

120. Haas, W.J. in Issues in Library Administration, edited by Tsuneishi et. al (Columbia, 1974, page 3)

121. Yasuda, M. in Issues in Library Administration (supra,120), 27

122. Vosper, R. in Issues in Library Administration page 38.

American library directors are different (122) and hold academic qualifications in librarianship rather than departmental disciplines, and their German counterparts are also librarians and administrators rather than academics (122). Takatori (123) presents the Japanese situation as a dichotomy where the librarian in only 22% of cases becomes a member of a university senate, and where professional librarians are never directors (124) and only 6.3% of all Japanese academic institutions (none of them national or public universities) have full-time library directors, none of these being professional librarians. (125). Much more could be written about the disparate measurement of skill, ability and professional and academic training, but sufficient has been written to show that although, in the specific case of public libraries, the relative frequency of professional staff is the best index of investment in training for the United Kingdom, it has limitations because:

(i) it is not a sufficient measurement for British academic libraries (118); and

(ii) it is neither a necessary nor a sufficient measurement for foreign libraries, e.g. Japan, where there is greater co-operation between academic and public libraries (124).

9.4. Some measures of training investment and their usage

Sufficient has been written to show that the real measurement of investment in library training is complex, and that the use of the frequencies of qualified staff is a limited, but not unreliable estimator. For the purpose of this section we can consider such ratios as:

(i) the frequency of qualified staff per unit of population;

(ii) the ratio of qualified staff to aggregate staff; and

123. Takatori: (op cit, supra, 120) page 55.

124. ibid. op cit, page 57, compare with 121 supra.

125. ibid. op cit, page 59.

(iii) the extent of investment in training programmes.

Alternatives (i) and (ii) are easy to calculate, but do not provide adjustment for investment that has been forgone because a librarian qualifies under one authority and afterwards moves to another, while (iii) assumes this complexity. For the purpose of examining controlled effects measurements (i) and (ii) are better than (iii) for they measure relevant investment and disregard transfers to and from authorities. It may be objected that (i) and (ii) are not 'financial' measurements, but library salaries are standardised, and inter-authority variability in scale and rank is less than inter-authority variability in qualified-staff frequencies. Further, the ratios are more relevant to our study than several propounded in respectable academic library research publications, e.g. crude ratios between regular and non-regular staff and between library staff and students. Since (a) libraries for public use are more homogeneous than academic libraries and (b), the relative frequencies under (i) and (ii) above could be converted into capital equivalents by application of a constant, they become powerful estimators of human investment.

Before we apply alternatives (i) and (ii) listed at the head of this section let us ask whether, despite the Roberts Committee recommendation, (119) the ratio of qualified to unqualified staff is non-variable. The correlation matrix in Table 66 provides the extent of correlation between professional, non-manual and manual library staff for London, the upper coefficients being based on 1970/71 values and the lower coefficients based on 1971/72 values. The coefficients are high, but London populations vary between 150,000 and over 300,000 and they suffer from uncontrolled partial correlation with population size. For the English counties the uncontrolled coefficients are, of course, even higher, but when controlled for population the coefficients are all significant, in both cases, at the 5% level of significance.

Thus any research into the effect of 'training' on issue statistics has to be pursued in a highly standardised situation, where, though the Roberts recommendation has not been thoroughly implemented, there is less variability in the ratios of qualified to unqualified staff than would be required for a thoroughly satisfactory study of the effect of investment in training on the issue statistic. Table 66 provides, from the London boroughs, some of the correlation coefficients between Professional Staff, Non-Manual Staff, Manual Staff and the Cost of Employees for the years 1970/71 and 1971/72. The coefficients are not controlled for population size, and the variability of population size (150,000 to over 300,000) should be taken into account when examining each pair of coefficients. When controlled for population the coefficients are lower, and it must be remembered that London is a special case with some commonality of policy because of such bodies as the Association of London Chief Librarians, and for the reasons investigated in the previous chapter. Thus we may expect high correlation coefficients for London, there being higher coefficients between frequencies of professional and non-manual staff than between either of these variables and the frequencies of manual staff.

In the English counties the high coefficients mainly result from differences of population size, the coefficient of variation is high (0.5) for all three variables, and the situation is more satisfactory for investigative purposes. Let us then use the measures proposed at the beginning of this section to examine whether there is an association between either of them and the issues of county libraries per head of population.

The first measure proposed was the frequency of professional posts per unit of population. The 'thousand' unit is most satisfactory for this purpose. It suffers from the disadvantage of all 'per capita' statistics, that the optimum allocation of staff per unit of population need not, in any case, be a linear one, and that the effect of extreme cases may be exaggerated by assuming a linear relationship. This measure did not alter significantly between the years 1970/71 and 1975/76, but the use of late statistics is undesirable, because it is intended to measure the effect of investment in staff training on the issue statistic. The changes are so insignificant that the measurement of the effect of such changes would not be profitable. It is useful to assess, however, whether the typical 'per capita' establishment of professional staff had its effect on changes in the issue statistic, when measured relatively to the size of each county. For example, if the Isle of Wight had, in mid-period, 15 professional posts to its 112,000 population, can it be said that the ratio (0.13) of professional posts per 1,000 of population can be related to the 'progressiveness' of the book-borrowing statistic for that county?

I have shown elsewhere that 'per capita' statistics are limited, so another measure of investment in training is needed. I use the term 'investment' to mean either the acquisition of a professionally qualified librarian who has trained elsewhere, or the training of a new qualified librarian, for the relative capitalised values of qualified staff are more important than the means of acquisition. The main disadvantage of the first measure is that the optimum relationship between staff and population size may not be linear, i.e. the ratio may not be a constant. We may therefore use a second measure, that ratio of professionally qualified staff to aggregate staff, as a check on the inadequacy of the first ratio.

From the attempts to implement the recommendations of the Roberts Report and subsequent reports, we may expect the variability of both measures to be low, and this is indeed the case. The first ratio, that of professional posts to 1,000-size units of population, has a mean value of 0.13375 (for English counties) and a standard deviation of 0.0215, a coefficient of variation of about 16%, while the ratio of qualified staff establishment to aggregate staff has a mean value of 0.28025 and a standard deviation of 0.0475, for English counties at the mid-point of our period. The coefficient of variation is again about 17%.

The values of the first variable range between 0.08 and 0.18, but there are very few extreme values. Thus, the ratio appears to be high in Wiltshire, Hertfordshire and some of the northern counties. There is an association between some high values of the ratio and counties whose issues per capita were generally higher than the mean through the period, but no association with changes (positive) in issues statistics.

The values of the second variable range between 0.19 (Cornwall) and 0.39 (Northamptonshire), and while there is some association between the extreme values of both variables (measures of investment in professional staff) it is not consistent. For example, although Cornwall has a small proportion of professionally qualified staff in terms of aggregate establishment, its frequency of professionally qualified staff per 1,000 of population is not small.

Nevertheless, there is a correlation between the two sets of measurements. In the most typical year (1972/73) of the four year sequence for which these values were calculated, the correlation coefficient between (i) the ratio of professionally qualified staff per 1,000 of population and (ii) that of professional staff to aggregate staff was 0.653. Thus they are comparable measures of investment in professional staff, though they are not entirely consistent. We may thus ask whether these different and limited, yet comparable, indicators are correlated with any of the indices proposed earlier in this thesis.

Table 67 provides some coefficients between these mid-period ratios and indices I, J, K, and L. It can be seen that neither measurement of investment in 'human capital', using the only suitable measures of those proposed earlier, is significantly correlated to indices I, J, K and L. We showed earlier that indicator L was preferable, and the highest correlation coefficient relates this index to the frequency of qualified staff per 1,000 population. But we also showed that this measurement of relative frequency of qualified staff was a limited one, and the actual coefficient is, of course, not significant where $n = 39$. It seems more appropriate that there should be correlation between a population-based measure of qualification and training and the issue statistic, than between a staff-based measure of qualification and training and the issue statistic, because some authorities may be either overstaffed or understaffed as the case may be, and the latter ratio has the disadvantage that it does not measure the extent of overstaffing or understaffing, either generally or in terms of manual and non-manual staff specifically.

Because the second ratio has these disadvantages we cannot dismiss the correlation coefficient of 0.2 between the first ratio and the index L entirely. But the first ratio also has limitations, and no composite measure of investment in professional staff provides any useful correlation with index L, though such a composite measure may compensate for the limitations of both the measurements that we have used.

Finally, we cannot, of course, dismiss the probability that investment in training may have a more definite long-run effect, but we can state with confidence that there is much greater objective evidence for the effect of capital expenditure on buildings on the issue statistic, than there is for an effect of the capitalization of human resources (e.g. as estimates of the 'worth' of qualified staff or of training) on the issue statistic as a measurable short-run consequence.

9.5. Summary and Conclusions

These are provided in Chapter 10, 10.2. Conclusions 79 to 81.

Table 66. Correlation Coefficients between categories of staff establishment (inter se) and aggregate salaries (London)

	Professional Staff	Non-Manual Staff	Manual Staff	Employees' Salaries
Professional Staff	1.000 1.000			
Non-Manual Staff	0.608 0.714	1.000 1.000		
Manual Staff	0.690 0.654	0.602 0.576	1.000 1.000	
Employees Salaries	0.875 0.895	0.878 0.899	0.786 0.766	1.000 1.000

Note . Upper figures are 1970/71, lower ones 1971/72.

Despite the fact that London is a special case because of (i) the reasons given in chapter 8 and (ii) some evidence of common policy because of organizations such as the Association of London Chief Librarians, these coefficients are low when controlled for population size. Hence there is some variability despite standardization.

Table 67. Some correlation coefficients between ratios of qualified staff (i) per unit of population and (ii) per aggregate staff frequency and indices I, J, K, and L

	Indices of Change in the Issue Statistic			
	I	J	K	L
Qualified Staff per unit of population	0.054	0.129	0.117	0.200
Qualified Staff as a proportion of total staff frequency	0.046	-0.099	0.041	-0.048

Note.

Both ratios were measured in mid-period but are typical, in most cases, of the ratios throughout the whole period 1969/70 to 1975/76. Both ratios have their demerits, and despite the upper L coefficient, it can be said with confidence that there is no significant short-run effect of investment in qualifications on the issue statistic. The long-run case was not investigated, because the changes in other variables would have limited the value of such an investigation.

Chapter Ten. Conclusions and Recommendations

10.1. Introduction

The purpose of the research on which this thesis was based was to test the hypothesis that (i) Hicksian models of the type:

$$V_o = \sum_{o}^{n_y} \frac{I_j}{(1 + r)^j}$$

(where V_o is value in time 0, I is income, n_y a number of years, and r a rate of time-preference) can be sufficiently accurate to be of practical use in investment problems of public libraries, and that (ii) capital investment inputs are related to income (I) defined in social benefits in such models.

The problem of defining income required consideration of different methods of estimation and categories of benefit, for the only monetary income (i.e. rents and fines) can be treated as cost-reduction, and is so relatively small as not to be of significant use in such models.

Benefits are categorised by librarians as 'book' and 'non-book'. 'Non-book' benefits are excluded from our terms of reference because of their diversity and because the bulk of them (e.g. storytime sessions) do not require significant additional capital, except, for example, when they involve constructing theatres and lecture theatres (e.g. Grays, Camden (St. Pancras) and Brighton) where costs and benefits can be categorised independently of those for library construction

'Book' benefits, on the other hand, may be considered either (i) in terms of their 'ultimate' value to library users, using models similar to those employed by Becker, Blaug, Sheehan and Vaizey in education and the valuation of human capital or (ii) in terms of their opportunity cost to readers in time t_o. The accuracy of the first method is to be questioned, but the second method may provide a sufficiently accurate estimator for practical purposes.

It had been shown in an earlier thesis (6) that the frequencies (or relative frequencies) of bookloans, i.e. issues (or issues per capita) are a useful estimator of the benefit (or social income) from lending activities and if it can be shown that, because of the relative size of the lending activity, its correlation with other (i.e. non-lending) activities and its contribution to the achievement of public library objectives, lending library statistics not only provide an accurate estimate of the benefits to a public from lending, but also from other (non-lending) 'book' activities (e.g. reference, reading room and lending library 'browsing', and access to information by using relegated reference stock and inter -library loans), then a model of the type:

$$V_o = \sum_{o}^{n_y} \frac{(n_i m_i - c)_j}{(1 + r)^j}$$

may be useful in estimating the total capitalized value of income from 'book' activities (lending and non-lending) where n_i is the annual number of bookloans, m_i is a conversion factor to express the relative income equivalent of a single bookloan not only in terms of lending, but of other 'book' activities, c is annual cost and the other variables are as defined earlier.

The second part of the hypothesis could be tested, first by determining whether capital investment is associated with issues, and consequently with benefits and with social income, and subsequently whether any particular subcategory of capital investment (i.e. buildings, mobiles, books and human capital) is so associated.

The first part of the hypothesis was tested in chapter 1, while chapter 2 examined the causes of variation in the issue statistic, to assess their relative importance in general, and the relative importance of capital investment in particular. The correlation coefficients between marginal differences in capital investment per capita and those in issues per capita may be affected by extreme values in their frequency distributions, and thus the frequency distributions of both variables were examined in chapters three and four respectively. Chapter five asked whether there is a generally evident association between capital investment and changes in issues (per capita) using sample data from English counties, while chapters six, seven, eight and nine examined in turn the effects of capital expenditure on buildings, mobile libraries, books (to the extent that they can be categorised as capital expenditure) and human resources, on the issue statistics, using both the main sample and additional evidence from other sources.

In this chapter we propose to examine the results of the particular conclusions from each chapter. Before generalising we shall list these particular conclusions in 10.2. Then we shall move to general conclusions in 10.3. Finally, although it is stressed that this research is of a theoretical rather than of a practical nature, we shall nonetheless, in 10.4. offer some recommendations that follow directly from our conclusions.

10.2. Some Particular Conclusions

1. The long-term (ultimate) benefits of public library activities at time t_o , either of an individual or of a community, cannot be estimated with the degree of accuracy required for capitalization in cost-benefit models (1.2.(i)).

2. While the methods described in 1. are useful for education cost-benefit analysis (e.g. aggregating the effects of an educational activity in time t_o on individual development in t_1 ....t_j) the method is not applicable to public library systems because of reader-mobility and the inter-availability of tickets and because some library activity is not of a human investment nature (i.e. education) but is for consumption (i.e. enjoyment at t_o) and can therefore be valued as a benefit in time t_o (1.2(i)).

3. It is insufficiently accurate simply to ask a sample of readers for estimates of their annual benefits from the public library service, aggregate these estimates

and then transform the sample aggregate into an estimate of the population aggregate annual benefit, for most readers would be unable to make estimates of the total benefit from libraries with precision (1.2(ii)).

4. Membership statistics and issue (i.e. loan) statistics are the two most frequent categories of library statistics. Of these, membership statistics are not a useful estimator of the level of library activity because of the dispersion in the frequencies of books borrowed per member, and because they are often dated by a mean length of one year, but the question whether the statistics of issues (i.e. bookloans) can be a useful indicator of total library activity, because of its satisfaction of library objectives, its relative size and its correlation with other 'book' activities, merits investigation (1.2(iii))

5. Though it was shown that academic libraries have specific objectives and demands (often related to their particular branches of knowledge and education) the objectives of public libraries are of a 'total' (i.e. global) nature and must be conceived as a total set of inter-related entities, of the kind listed by library reporting committees (1.3(i)).

6. The lending function satisfies more of these inter-related objectives than other functions (1.3(i)).

7. From the standpoints of provision of readers' needs, public estimation, use of resources and in most other respects the lending function is the largest of library activities. It can, in a 'management accounting' sense, be understood as a 'main product' activity, accounting for over 90% of total activity (1.3(ii)).

8. Lending activity is also a useful estimator of total library activity (except 'non-book' functions) because there is a good correlation between it and all useful indicators of non-lending activities (e.g. browsing, reference consultation etc.) using either readers' estimates of comparative values of each activity, frequency counts of books consulted or frequency counts of people engaged in these activities at comparable times.

9. Although each title obviously has not the same value (as a loan) as another, it is also true that one title has not necessarily the same loan value to two different readers, nor has the same title necessarily the same value to the same reader when borrowed at two different points of time. Thus, an estimation of the benefit of bookloans using specific values for each book, is not only cumbersome but may not be accurate (1.4).

10. Instead, it is preferable to assess whether the values of bookloans are a variate having a modal value and a known frequency distribution. (1.4.).

11. Questionnaires showed that most people preferred to regard the benefit from library services either as (i) a function of the frequency of borrowing, or (ii) a constant (e.g. an annual value). Thus, there is shown to be little merit in the procedure described in 9 above (specific aggregation) for there was no evidence that all readers associated the 'loan value' of each book necessarily with its commercial value. (1.4.).

12. Instead, the loan values of books are a variate (m_1) and have a positive asymmetric frequency distribution with a mode of 36p. The values of non-lending benefits (e.g. browsing, reference, information services, inter -library information etc.) are not only highly correlated with this variate but have similar frequency distributions (1.4)

13. Thus these other benefits can be apportioned and added to the estimate of 36p (see 12) so as to provide ($m_1 \ldots m_j$) a conversion rate (of approximately 46p) for estimating all 'book' benefits, both lending and non-lending from issue statistics. The statistic needs adjustment for some libraries For example, some benefits (e.g. reference facilities) are not provided directly by mobile libraries. (1.4.)

14. Thus, social income can be estimated with some accuracy from lending library bookloan statistics even though they themselves represent only a proportion of total benefits (1.4).

15. As the value of a library investment may be regarded as a discounted stream of benefits (both lending and non-lending) estimated from bookloan statistics, it is now required to test whether there is a measurable relationship between capital inputs and 'benefit' outputs so estimated (2.1.) .

16. If one adopts a 'tabula rasa' approach to examining the causes of variation of library issues, many of the causes suggested by librarians are too specific (and local) for model-building, but some, such as population size, library membership, opening hours, expenditure on bookstocks, expenditure on employees and the influence of schools deserve some consideration so that the specific effect of capital expenditure on the issue statistic may be isolated (2.2).

17. Population size was shown to have no direct effect on issues, when taken per head of population, except for a minor effect related to population density and the optimal size of a library authority (2.3).

18. The suggestion of Stoljarov (supra), that issues are mainly a function of library membership, was examined using primary data and secondary data, and it was shown that issues per member are a variable with as great a dispersion as issues per head of population generally (2.3).

19. Other regressors were excluded, for various reasons, but three variables were retained for further examination. They were (i) indigenous characteristics of a regional population, related to social class and school-leaving age; (ii) expenditure on books and (iii) capital expenditure. Of these, even expenditure on books could be subsumed under capital, and variable (i) was a matter for long-term change (e.g. via the influence of schools) so that capital expenditure seemed to emerge as the principal variable for consideration (2.3).

20. This was supported with time-series evidence. Although the trend of the variable, issues per capita, appeared to be curvilinear between 1880 and 1978, an examination of absolute values of issues from libraries showed a more

complex trend, consisting of geometric and linear components, but with episodic changes of direction at about 1925 and 1950 (2.4).

21. Given a four-year lag for decision-making, capital expenditure and building, these dates coincide with termini ad quem of periods of significantly large capital expansion and empowering legislation for both library building in both cases and the development of mobile libraries in the latter case (2.4).

22. No other reasons (e.g. radio-discovery and the invention of television) provide a satisfactory hypothesis for both episodic changes of direction (1925 & 1950) in the trend line (2.4).

23. Thus the hypothesis that best fits historical data is that though the steady increase in absolute frequencies of issues can be attributed to factors (i) and (ii) in 19 supra, the episodic changes in the direction of the trend line can only be attributed to factor (iii), i.e. capital expenditure (2.4)

24. But before pursuing the hypothesis suggested by the historical data, that permanent trend-direction changes do not result from (i) or (ii), but from factor (iii) in 19 supra , it was still necessary to examine an alternative hypothesis that issues were affected by revenue expenditure other than those on bookstocks (2.5)

25. There was no evidence of correlation between revenue expenditure and issues from libraries in the case of county authorities (2.5).

26. The specific study of London (as a special case) using both 'per capita' variables (2.5(i)) of all boroughs, and absolute variables of similarly sized boroughs (2.5(ii)) also produced no evidence of significant correlation between revenue expenditure and issues from libraries.

27. Finally when absolute values of revenue expenditure and the issues of a sample of similar-sized non-London boroughs are tested, the correlation coefficients are not significant (2.5(iii)).

28. On the other hand, even in London, where there is evidence of positive (but not significant) correlation between revenue expenditure and issues, there is greater evidence of a long-term correlation between capital expenditure and issues, when both are expressed per capita (i.e. per head of population) (2.6).

29. Thus, there was prima facie evidence that issues are primarily affected by capital expenditure, but this hypothesis required testing from a suitable sample, taking yearly increments to capital stock (per capita) and correlating them with changes in issues per capita, but before doing so it was necessary to assess whether the frequency distributions of both these variables affected our analysis (3.1.)

30. Our choice of English (and Welsh) counties as a sample for testing the hypothesis was determined by the atypical effect of using London data only (as in the M.Phil thesis) and by the differing legislation for Scotland and Northern Ireland (3.1).

31. The most recent period for an analysis that would both allow for inter-period variability and for the four-year lag for capital decisions and building (21 supra) is the period from 1969/70 to 1975/76, using two years (1969/70 and 1970/71) as termini a quo and two (1974/75 and 1975/76) as termini ad quem (3.1).

32. Using <u>all</u> authorities of England and Wales, the frequency distribution of issues per capita was shown, in all cases, to be positively asymmetric, consisting of two components (a) a constant k, increasing from 4.2. (in earlier years) to 6.0; and (b) a Poisson component with a diminishing mode, but with (c) an overall increase in the mode of the distribution from 11 to 12 issues per capita, but an insignificant decline in the mean. The distribution was more 'peaked' for counties and there was greater 'bunching' around central location, and a decline in the frequency of extreme values at the end of the period (3.2-4).

33. Such extreme values can, however, affect the correlation coefficient (3.4).

34. The study of the variable, capital expenditure per capita, showed that it was also asymmetrically distributed, and that there was also, in this case, the problem of the effect of extreme values on the correlation coefficient with issues per capita (4.2–6).

35. There was also an associated problem, that values expressed per head of population are not necessarily comparable with each other, and that geographical size is sometimes a more relevant standard for common comparability than population size. This problem is explained fully in chapter 6. (4.2. & 6.2.).

36. The sub-categories of capital expenditure are poorly correlated with each other, because they are competitive. In this context capital expenditure on libraries is a 'minor' category and often treated as a 'residual' in comparison with 'major' categories (e.g. education) (4.3)

37. Thus, capital expenditure on libraries (similar to that on highways) tended to be highly-geared, i.e. oversensitive to expansion and contraction in the aggregate capital funds available in any particular year, reaping relatively generous allocations when capital funds are available, and suffering disproportionate restriction when aggregate capital funds are restricted (4.3 – 6).

38. The weakness of the 'per capita' approach was indicated by the difference (i.e. non-linear) in the regression functions for large authorities compared with small authorities (4.3).

39. A study of the capital expenditure (per capita) statistics for 1974/75 and 1975/76 showed them to be less widely dispersed because of the effect of local government reorganization, but as they are not well correlated to increases (or decreases) in issues per capita, they are of no importance for our study (4.6)

40. The limitation of the use of 'per capita' statistics was also illustrated by a correlation of aggregate absolute capital expenditures with the main categories of capital expenditure and with capital expenditure on libraries using absolute values of all variables. Library

expenditure was shown to be less highly correlated with population size than any of the capital expenditures in the 'major' categories (e.g. education)(4.6.).

41. However, despite the oversensitivity of library capital expenditure to changes in aggregate funds available, an inter-period correlation showed that English counties followed a consistent pattern between 1969/70 and 1973/74, i.e. generous counties remained generous and stringent counties stringent, except in isolated cases where overexpenditure in one year compensated for underexpenditure in an immediately neighbouring year (4.7).

42. This pattern of consistency partly reflected the effect of large central projects, but there is no evidence of consistency subsequent to 1973/74 (4.7).

43. This consistency exists between 1969/70 and 1973/74 despite the theoretical premiss that each annual unit of capital expenditure is 'one-off', 'once-for-all' in nature. That is, once a library has been completed in a particular locality it will be unnecessary to spend further units of capital in that locality for a very long period (5.2).

44. In this respect capital expenditure differs from issues, for the evidence suggests that there is usually a good time-series (i.e. inter-period) correlation between issues per capita, arising largely,for example, from existing indigenous population characteristics and existing capital stock, to which annual capital expenditures are increments (5.2).

45. Thus, it is logical that capital expenditures per capita be correlated (as increments to total capital stock) with increments in issues per capita, over a suitable period (5.2.)

46. The inter-period consistency of capital expenditure between 1969/70 and 1973/74 is not a valid counter-argument for it was shown to have resulted largely from the effect of long large 'phased' central library projects (5.2.)

47. A simple, preliminary, non-parametric test, using the means of both variables as class-value boundaries, showed that those counties whose capital expenditures per capita were lower than the mean did experience a decline

in issues per capita over the period. This non-parametric test was useful, because correlation coefficients could be overaffected by the extreme values (per capita) of small counties, though a special study of small counties indicated that this problem was not a great one (5.2).

48. A further precaution against the dangers of 47 supra was to remove Rutland and the Welsh counties from the sample because of their small populations, but the sample size was not reduced below 39, in order to preserve statistical validity (5.3).

49. Four indices of change in the issue statistic between the years 1969/70 and 1970/71, and 1974/75 and 1975/76 were proposed, I, J, K, and L, using 1969/70 as a base for I and K and 1970/71 as a base for J and L. Indices I and K were shown to be weak because of the atypical nature of 1969/70 data, as was a further index M, in which the mean of 1969/70 and 1970/71 data was used as a base (5.3.)

50. There was shown to be a significant correlation, at the 1% level (i.e. 0.588) between capital expenditure per capita in 1969/70 and index L, registering changes of issues per capita between 1970/71 and 1975/76, but not between later capital expenditures and this index nor between the mean capital expenditure for all years and index L, despite the high inter-period correlation (5.4.).

51. Two hypotheses were proposed (i) that the changes of issues per capita were responsive to the inter-period mean capital expenditure per capita and (ii) that the changes of issues per capita were responsive to capital expenditure per capita early in our period. Hypothesis (i) was rejected and hypothesis (ii) was accepted. (5.4(i)).

52. The greater weight of evidence for hypothesis (ii) did not result simply from the longer time-lag for capital expenditure to mature. It was because earlier projects were smaller and more widely dispersed than the later long large central library projects, given sanction when funds were available, but postponed and re-phased when funds were more stringent (5.4(iii)).

53. The gearing effect of the oversensitivity of libraries to expansion and contraction of aggregate available funds during the period, thus contributed not only to the rephasing of central library projects but to the abandonment of some small projects and the implementing of less ambitious schemes for others (the Giffen effect). Thus, much of the capital expenditure of later years had no immediately visible effect because it involved expenditure on uncompleted large projects (5.4(iii)

54. The statistics of 'general' capital expenditure were also distorted by other factors (e.g. differences between primary and secondary data and funding of mobile libraries from revenue sources). (5.4(iv) and (vi)).

55. The non-effect of long, large uncompleted projects proved an obstacle to hypothesis (i) but not to hypothesis (ii) (51 supra). Largely because of this obstacle (54 supra) and thus a useful method of testing that issues are a function of dispersion of capital expenditure (i.e. on small projects) is to test whether an increase in the frequency of service points between 1969/70 and 1973/74 is associated with an increase (or decrease) in issues (6.2.)

56. But again 'per capita' tests pose problems, for some categories of part-time libraries are more correlated with geographical size in their frequency than with population size. Thus, only full-time libraries may be used for our analysis. This is reasonable because all building expenditure is upon full-time service points. Other service points are usually rented (6.2.).

57. There was seen to be a significant (but not highly significant) correlation between changes in frequencies of full-time service points per capita and changes in issues per capita (6.2.)

58. Frequency distributions were compiled from data of individual projects for the years 1969/70 to 1970/71, supplied from capital estimates, librarians' letters, and from the two publications New Library Buildings. The modes of the distributions were low (especially for 1969/70) and large projects were a special component (very few) (6.4a-b).

59. There is evidence that the mode of the distribution increased significantly after 1971, reflecting not only inflation, but a 'real' increase, and indicating:
(i) a 'go-ahead' for large (e.g. central library) projects following the 1972 Act; and
(ii) a subsequent 'cut-back' resulting both from less resources, and from inflation. (6.4c).

60. For the period 1972-4, only one-fifth of a relatively large sample accounted for nearly 40% of aggregate cost, and, because these large projects were often not completed in sufficient time to effect changes in the rates of issues per capita, there was no significant association (using a 2 x 2 test of medians) between these large projects and the related authorities whose issues per capita increased over the period using Index L (6.4c).

61. The change of emphasis from 'dispersed' expenditure on small projects to 'concentrated' expenditure on long large, postponed and often incompleted projects resulted from the process outlined in 62 below.

62. The effect of inflation on small projects varied between 20% and 34% of aggregate cost, depending on the way that they were phased between 1972 and 1974, but the consequence of inflation and 'cut-back' on large projects was greater, thus:
(i) central projects that were nearing completion received preference, and <u>associated</u> branch projects (i.e. financed by the same authorities) were delayed;
(ii) central projects on which there were no committed costs were shelved;
(iii) central projects that had already received some substantial commitment were re-phased, and this postponement affected completion dates so that some projects were not completed during our period of reference; and
(iv) where central projects were shelved (ii), associated branch projects received more resources, but often the need to spend money on a 'superior' (e.g. central) project led to a 'Giffen' effect of reducing expenditure on an associated 'inferior' project through less ambitious planning, or of postponing the 'inferior' project (6.4d).

63. Thus, the reasons for the superiority of the hypothesis that issues (and consequently benefits, i.e. social income) were responsive to capital expenditure early in our period of reference, over the alternative hypothesis, that they were simply responsive to the inter-period mean capital expenditure, are not only evident (i.e. that (i) early expenditure was widely dispersed on small projects, but that (ii) late expenditure was concentrated on large projects), but these reasons are shown to be the direct consequence of (i) the 'gearing' effect of aggregate allocations on library expenditure as a 'residual' to major capital categories (e.g. education) and of (ii) a 'go-ahead' for large projects early in the period, followed by 'cut-back' in expenditure, leaving many authorities 'trapped' with uncompleted large projects (6.4d).

64. There was no evidence that subcategory differences of building expenditure contributed significantly to aggregate differences, or to the variability of issues, but non-building category differences (e.g. mobiles, books and human resources) needed further exploration as limitations of the principal hypothesis, and the conclusions of research in these areas is listed below (6.4d(v)).

65. Mobile libraries' frequencies and expenditures are better correlated to geographical size than to population size of county. Thus 'per capita' measurements are a statistically weak tool of analysis, without reference to some other standard of relative measurement (e.g. residuals between expected and actual frequencies), using a regression model based on both geographic and population size regressors. (7.2)

66. Fisher's test of association (2 x 2) using the medians of (i) issues per capita changes (i.e. index L) and (ii) frequencies of mobile libraries per capita, but judging (ii) by comparison using 65 supra, was the preferred method of testing non-linear association between the relevant variables, for the relative mobile library frequency has some small differences using the two standards of measurement (65 supra) and the frequency of mobile libraries per capita

is highly asymmetrically distributed (7.2(ii))

67. Further, the revenue (i.e. maintenance) factor in mobile libraries is such that, unlike the case of library buildings, frequencies (per capita) rather than changes (e.g. increases) in frequencies per capita should be used for correlation with the issue index variables (e.g. L supra). A non-linear test could be applied, compared with other forms of correlation, and exceptions studied specifically (7.2(ii)).

68. The Fisher (2 x 2) test association, using the medians of the variables (e.g. 1.2 mobiles per 100,000 unit) showed there to be a highly significant association between counties with relatively high mobile library frequencies and those with positive increases in the issues of books, but with some significant exceptions (7.2(ii).

69. The investigation of exceptions to the non-linear test of association showed these counties to have had a high pre-existent level of mobile library investment and of issues per capita, where a 'saturation point' had been reached, but that even in these cases, the mobile library ratios of issues/stock and issues/member were significantly higher than the fixed-point library ratios of these counties (7.3).

70. Thus, though mobile libraries have not the long-term effect on the rate of issues per capita that fixed-point libraries have (i) because of their impermanence; and (ii) because growth becomes saturated after initial interest, and though they lack some associated benefits (e.g. reference facilities, see chapter 1) yet they make a higher relative contribution to issues than do fixed point libraries (7.3).

71. Strictly, bookstocks demand consideration as a limitation of our analysis, because though not usually so categorised (i.e. mainly treated as 'revenue' in accounts) a bookstock <u>is</u> the library in a more real sense than either buildings, mobiles or human assets (8.2.).

72. But because of high usage-obsolescence in <u>public</u> (as opposed to <u>academic</u>) libraries (e.g. 50% in two years

after acquisition) it is preferable to regard bookstocks as quickly obsolescing capital (analogous to computers, for example, in industry) (8.2.)

73. It is self-evident that if bookstocks were treated as capital to be written off to revenue on a usage basis, there would be no doubt of correlation between such revenue debits and benefits (i.e. issues), for the variable (usage = issues) would effectively be correlated with itself. But the question whether annual expenditures on bookstocks affect issues demands further consideration (8.2.)

74. A review of the earlier work (M.Phil thesis) showed that in the special case of London there is good correlation between issues per capita and expenditures on bookstocks per capita (and between the former variable and quantities of books acquired per capita, especially in high-density London boroughs), but this is partly attributable to the high time-series autocorrelations of all three variables (8.3.).

75. Inter-year changes (i.e. increases and decreases) are positively, but not significantly, correlated, unless adjustment is made for boroughs with high interest in libraries, because of social factors, but work subsequent to the earlier thesis confirmed an earlier conclusion that there is, in the special case of London, a non-linear effect of real (i.e. inflation indexed) expenditure on bookstocks and issues, such that an increase in real expenditure per capita produces an increase in issues per capita, and a decrease in one variable produces a decrease in the other, except in a small minority of boroughs where the 'reading interest' (social class) factors were predominant (8.4.).

76. But work subsequent to the thesis showed that London is a special case, because of high and low 'pockets' of interest in libraries, social climate of specific boroughs, commuter effects, ticket-interavailability, special subject collections and static (in some boroughs, diminishing) frequencies of service-points (8.3 & 8.4).

77. London is also a special case because of the high time-series autocorrelation of the variables listed in 74 supra, but the intra-borough consistency did not result from other factors studied (e.g. fiction/non-fiction book acquisition policies or junior/aggregate purchase emphases), although these two ratios, for example, were persistently high or low in some boroughs (8.4).

78. The special case of London did not apply to the sample of English counties. It was not proven that a real increase in bookstock expenditure produced an increase in issues, except where such an increase was accompanied by an increase in service points, i.e. where the purchase of buildings and books (or mobiles and books) were twin aspects of the same capital decisions (8.6).

79. The third limitation of our analysis, human capital, was explored in chapter 9. There was no case for a factorisation of employees' salaries to estimate human capital (and subsequently correlate with issue increases) but there was a case for disregarding the salary variable (because scales are standardised) and correlating measures of the extent of training (and qualification) with changes in the issue rate (9.2.).

80. Measurements of qualification and training pose problems for academic (and, to some extent, public) libraries. Measures of investment in training programmes are not useful because of inter-authority transferability, but two measures: (i) the frequency of qualified staff per unit (e.g. 1,000) of population; and (ii) the ratio qualified staff/aggregate staff are of prima-facie use (9.2 -9.4).

81. But there is no evidence of correlation between either of these measures and the indices of growth in issues per capita (I,J,K and L) in the short run, though this does not contradict a possible long-term effect of training of staff on this measure of social benefit (9.5.).

10.3. The General Conclusions

1. The first part of the hypothesis, i.e. that measures of activity may be used to estimate the 'social income' derived from the 'book' activities of public library users, has been shown to be correct. It has been shown, for example, that lending library issues can be used to estimate the aggregate social income, both from lending and from non-lending 'book' activities, provided that:
(i) the values of the measures of location and dispersion of the opportunity cost of a bookloan are continually updated, so that they may be taken into account in converting actual statistics of issues of books from a library system, into estimates of aggregate social benefit from lending; and
(ii) non-lending activity is so well-correlated with lending activity that the values of reference, browsing and other benefits can also be estimated from lending library issue statistics (as the best index of total library activity) with sufficient statistical confidence, simply by adjusting the conversion factor.

2. With regard to (ii), the evidence of chapter one suggests that, though it is not the function of a librarian to maximise the issues from lending libraries, (any more than that of a bookshop proprietor to maximise only sales-quantity) there may be an even greater correlation between (a) library lending and (b) lending library browsing and other reference activities, than for example between bookshop sales and bookshop browsing, the latter not being taken into account as a component of the commercial income of a bookshop. So the case for using issue data is a strong one.

3. Further, no other measure is a sufficiently useful estimator. There is no evidence, for example, that the analysis of issues into either (i) subject categories or (ii) interval categories of the commercial purchase prices of books, and the use of different conversion factors for each category, would be useful in producing better estimates of aggregate social income from libraries, though the analysis of issues into (i) central; (ii) branch and (iii) mobile

library issues does tend to greater accuracy in the estimation of aggregate non-lending benefits because, for example, small branches and mobile libraries have no immediately associated reference functions. Further, membership statistics and 'overall estimates' of benefit by members are not useful in this context, for there is, for example, from a lending standpoint alone, 100 times the distinction between a member borrowing 100 books per annum and one borrowing 1 book, than between the latter and a non-member.

4. The second part of the hypothesis, that there is an association between (i) capital expenditure on libraries, and (ii) issues, (as an indicator of library activity, and consequently of library benefit), has also been tested in this thesis. It has been shown that, apart from social factors affecting the variability of issues from one region to another, and generally improving over time, via education, capital investment is the major contributor to the inter-period increases in the issue statistic, to the increase in associated non-lending 'book' activity and consequently to all categories of the social income that public libraries derive from 'book' activities, for it has not only been shown from a time-series historical study that episodic changes in the trend line of issues can be identified with periods of major capital activity, but (using a sufficiently large sample), that capital expenditure per capita can be correlated with changes in issues per capita.

5. Yet it does not follow that capital expenditure necessarily increases either (a) the issue statistic or (b) library activity generally. The marginal efficiency of library capital has been shown to be greatest when it has either been invested in a number of small, geographically dispersed projects or expended on mobile libraries, and lowest when invested in phased-concentrated central library projects (where, in the period of reference, the effects of 'go-ahead' and subsequent 'cut-back' was particularly acute). The marginal efficiency of capital expenditure on mobile library

development is (in terms of issue activity) greater than that on branch libraries, in terms of initial impact, but there is some evidence that a saturation point can be reached in the case of mobile libraries, where further investment is unproductive.

6. Although there had been evidence (from London boroughs) that issues are sensitive to annual expenditure on bookstocks, there is no evidence that this is generally true of public libraries, except where bookstock expenditures are associated with capital decisions (e.g. on mobiles and new libraries).

7. Finally, there is no evidence, from the available data, that library activity (qua issues) is sensitive to the extent of capital investment in staff training, judged by relative frequencies of staff as qualified personnel.

10.4. Recommendations and Suggestions for Further Research

From the seven major conclusions summarised in the section above, it appears that the best policy for library development is the geographical dispersion of capital expenditure on libraries, such that (i) access to either mobile libraries or fixed service points is given priority over the less tangible advantages of centralised administration, and (ii) the marginal efficiency of capital remains high.

There is no indication that other measures of benefit are as useful as lending library issues for the estimation of total 'book' benefit, while lending remains both the largest library activity and while it remains correlated with other 'book' activities, but as public libraries change, either by greater movement into cultural activities, or by becoming information centres with the part-substitution of tape, microfiche, videotape and computer-terminal facilities instead of books, there will be need to explore the parameters of 'opportunity cost' values of each of these sources of benefit and their association with relevant capital investment. The methodology could be a similar one, that of gathering public estimates of the 'opportunity costs' of such benefits.

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Note

In addition to the above, part-use has also been made of a number of other sources e.g:

(1) General Register Office. General Census (1971) England and Wales Report (Greater London) Part II.

(2) The Capital Estimates and Accounts of most English and Welsh authorities, with specific reference to English county library authorities.

(3) Published and unpublished data from those library authorities mentioned in acknowledgements, consisting of specific library statistics and of letters from county librarians,